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ESTABLISHED 1874

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The House of Obermayer

means---pioneers in manufacturing foundry facings and supplies.

Thirty-two years of growth and experience indicates success. We started small but didn't long remain so.

To-day we are selling our products to a majority of the leading foundrymen in this country.

If we didn't have their confidence and friendship we would not be in business. Old foundrymen know us---we want the new ones to know us also.

The progressive foundryman of today finds it to his advantage to buy from the house that manufactures

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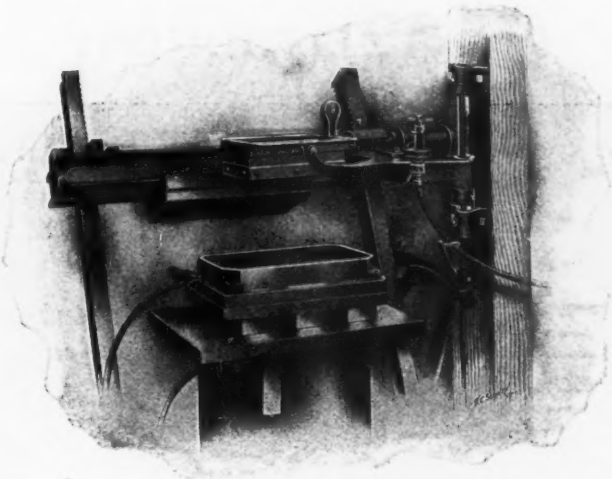

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This machine is found to be a big time and labor saver in screening sand into the flasks of Pneumatic Molding Machines. Operates automatically when swung into place and stops when swung away.

It is also found very convenient and profitable for bench molding.

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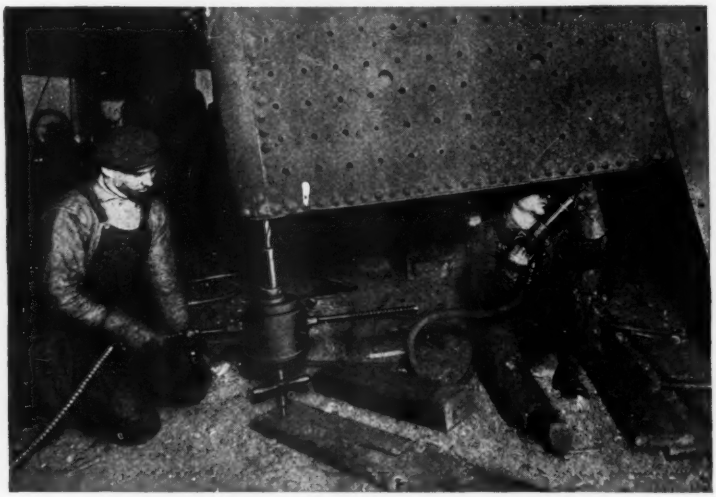
"HAESELER" AND "IMPERIAL"

AIR TOOLS

FOR THE FOUNDRY



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H27

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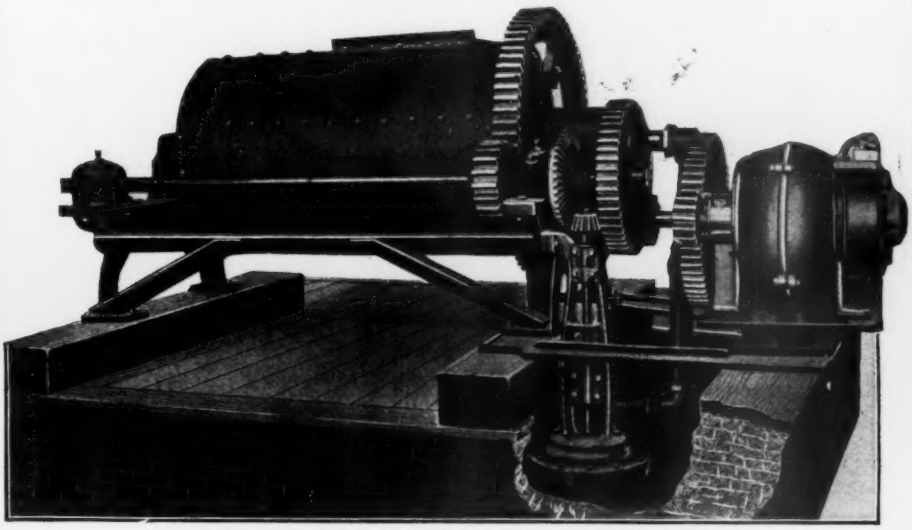

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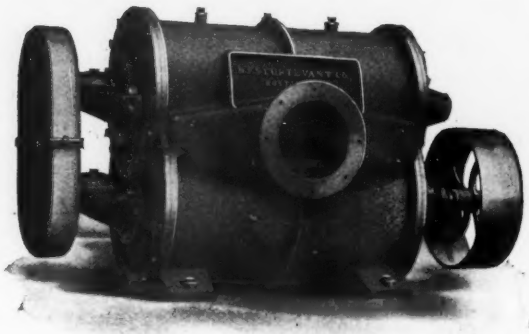

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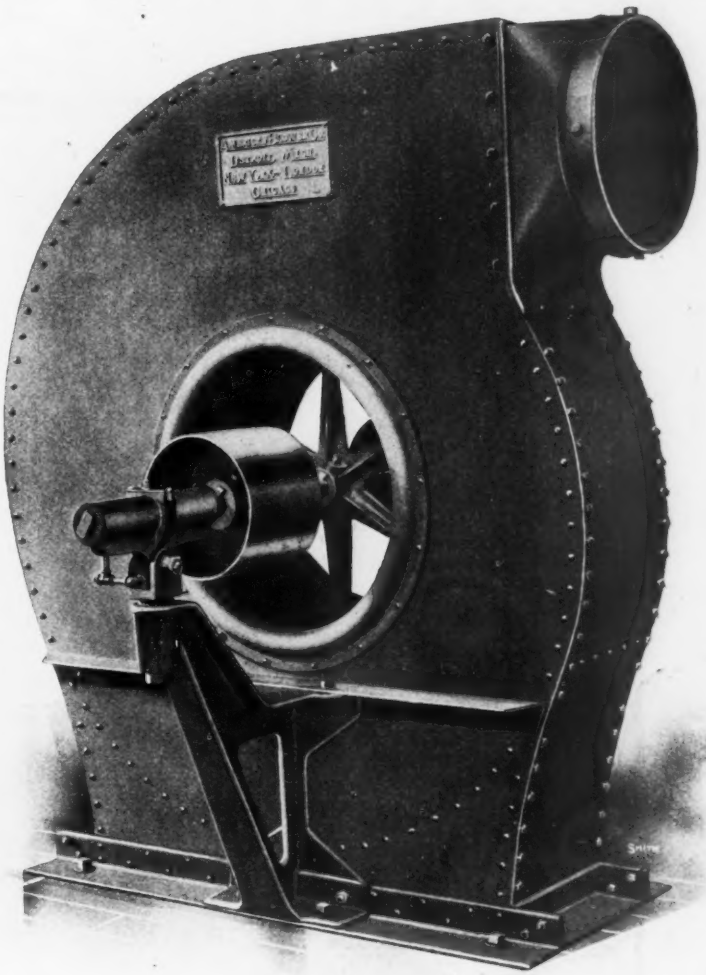
610

"ABC" Steel Pressure Blowers



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It is only in this careful and thorough manner of constructing and testing that the purchaser can be assured of a perfectly smooth and safe machine at the high speeds demanded in the class of work to which these Blowers are applied.

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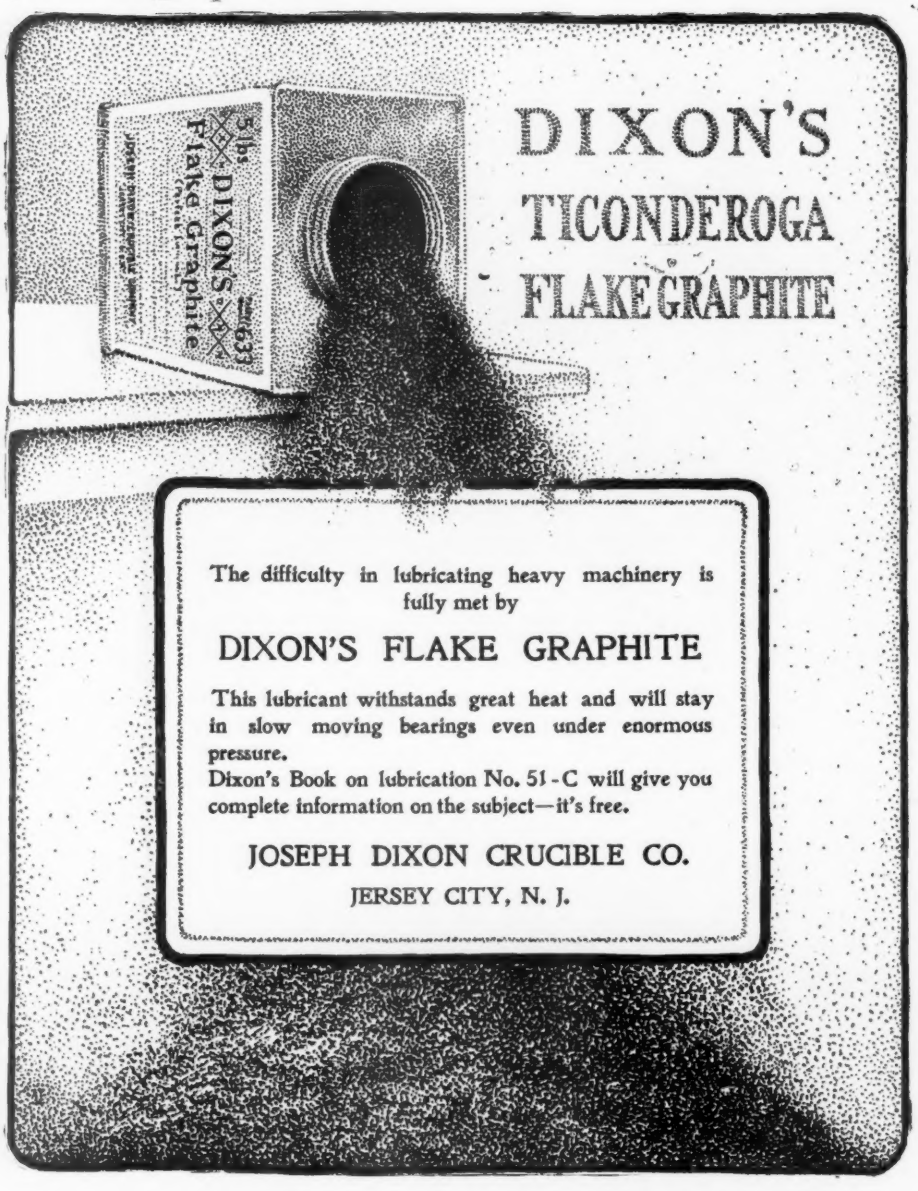
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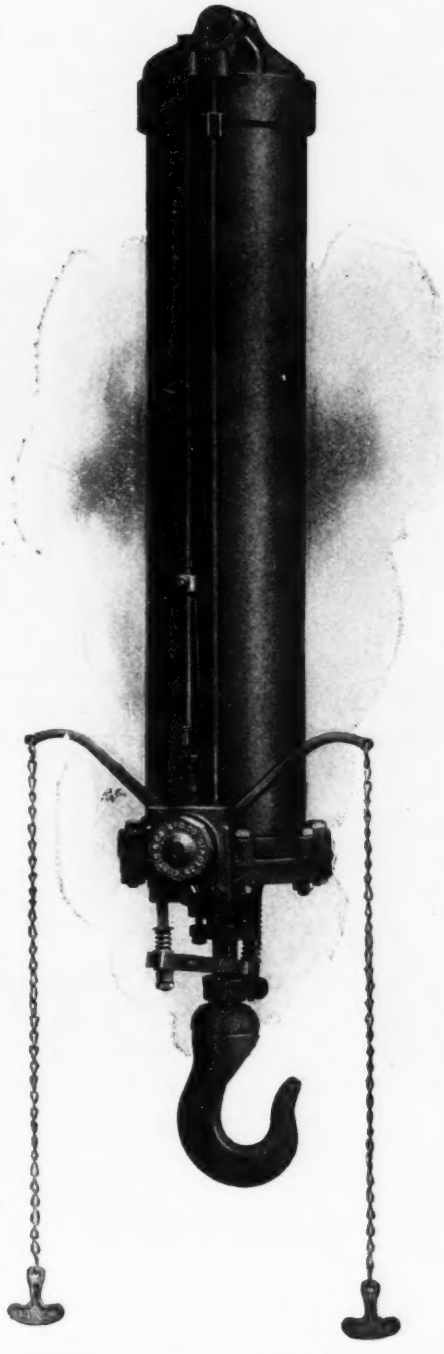

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Will Handle the Most Difficult Moulding

Made in sizes from 3″ diameter 450 lb. capacity, to 19″ diameter 20,000 lb. capacity.

PNEUMATIC ELEVATORS
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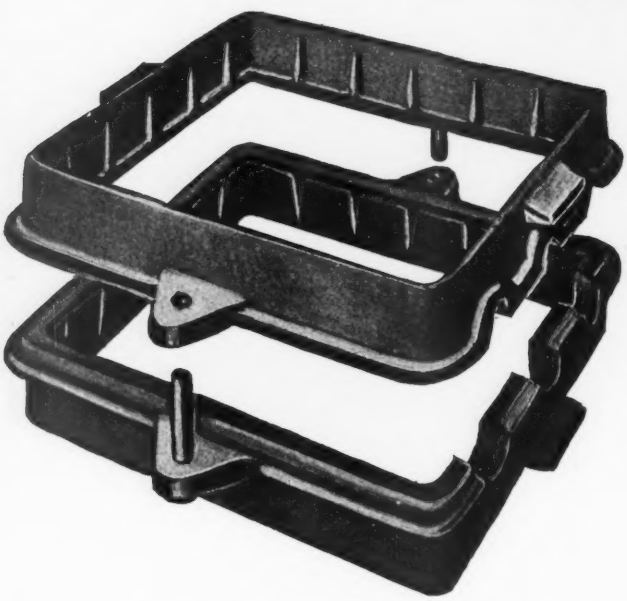
Brass Molders' Flasks

Of Every Style and Size

Furnaces, Drying Stoves, Spill Troughs, Clamps, Boards, Tongs, Crucibles, etc., etc.



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Our own foundries ensure prompt shipments.

THE OSCAR BARNETT <STANDARD> FLASK IS MADE ONLY BY

Oscar Barnett Foundry Co.

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It is a matter of satisfaction as well as of money-value to know that you can count on your hoists as economical and unvarying factors in the cost account.

Catalog F gives full information about Electric Hoists. Write today for it.

The Yale & Towne Manufacturing Co.

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Centrifugal Sand Mixing Machine

We have furnished these machines to many users and shall be pleased to supply full particulars upon application.

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Improved Injectors for Boiler Service

SHAFTS, HANGERS, PULLEYS, COUPLINGS, Etc.

FOR THE TRANSMISSION OF POWER.

Compare the Quality
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Cherry Valley Iron

the best for your foundry.
Soft, strong, uniform, fluid.

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The Cherry Valley Iron Co.
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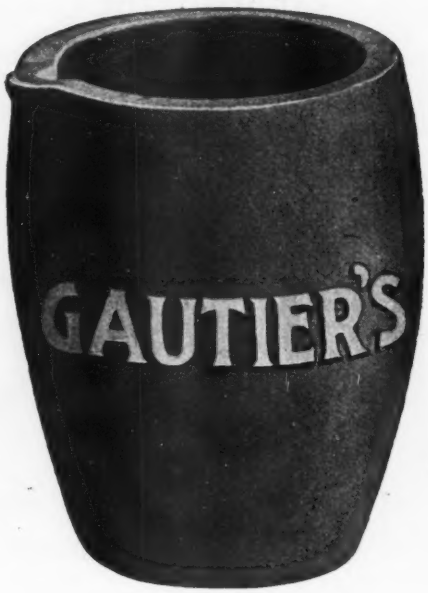
A Dependable Crucible for all Metals



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J. H. Gautier & Co.
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This trade mark stands for the acme of crucible uniformity.

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No. 1 for heavy or ordinary Core-making No. 2 for any work, but is especially adapted for Malleable Iron, Brass and Steel Foundries. It goes three times as far as Rosin, and twice as far as Flour. No blow and no absorption of moisture.

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Perfect adaptation for all work. Best Core Oil on the market.

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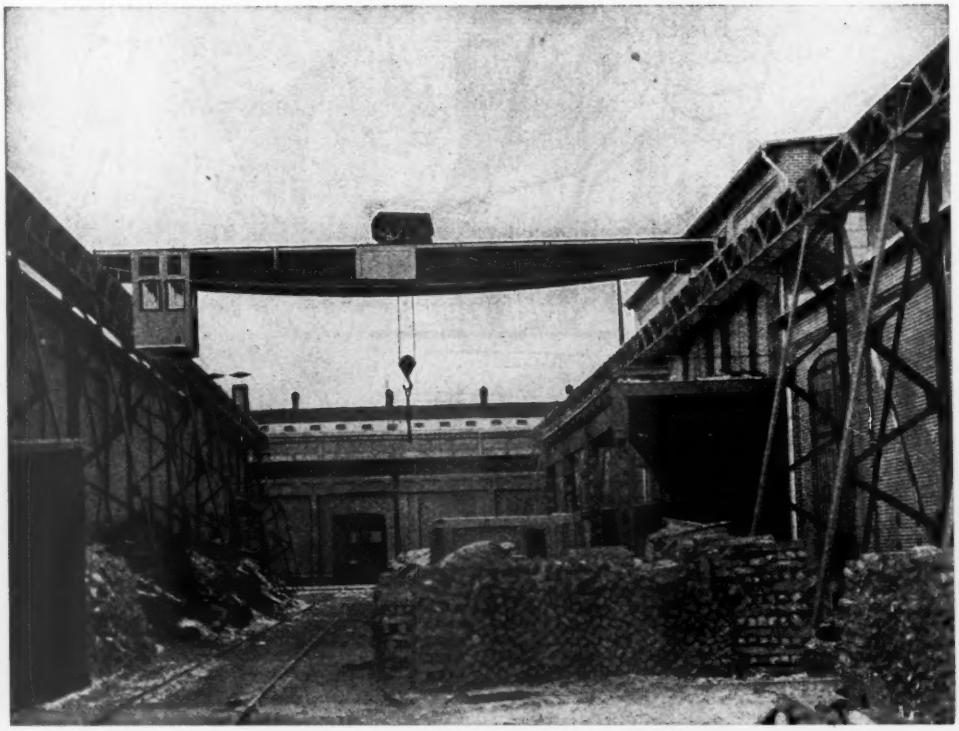

Three-Motor Electric Traveling Crane, 10 tons Capacity, for Canadian Pacific Railway, Montreal, Quebec. Serves as foundry elevator, handling all stock.

Cupola, 2000 in use.

Electric Travelers Cranes of All Types

Cupolas and **Machinery** for **Complete equipment** of **Foundry Plants. Contracts taken covering buildings** and **entire Installations. Inquiries Solicited.**

New Crane Catalog just out. Send for it.

THE FOUNDRY

Vol. 29, No. 2. *CLEVELAND, OHIO, OCTOBER, 1906.* *Whole No. 170*

The Steel Foundry Co., Cincinnati, O

Cincinnati is one of the largest machine tool centers in America, and in connection with the machine tool industry a large gray iron foundry industry has been developed. Many of the Cincinnati foundries have long been noted for the excellent quality of the work turned out, but local manufacturers have always had to depend on outside parties for steel castings. Lately the inconvenience arising from the difficulty in getting prompt deliveries has been so great that some of the local manufacturers decided to see what could be done to relieve present conditions. As a consequence the Steel Foundry Co. was incorporated, the owners being local manufacturers and business men.

A site 500 x 1,000 feet was secured on Winton Place, which is very near Ivorydale, the site of the noted soap industry conducted by Proctor & Gamble. This site has good railroad facilities for shipping purposes and for the delivery of raw material. Cincinnati also possesses certain marked advantages as a steel foundry center, as it is situated midway between the northern and southern iron fields and hence can secure any grade of iron at very reasonable terms. There is also a very large amount of local scrap which can be worked up by the

CHEMICAL LABORATORY.

WHITING FOUNDRY EQUIPMENT CO.

General Office and Works, HARVEY, ILL., U. S. A. (Chicago Suburb)

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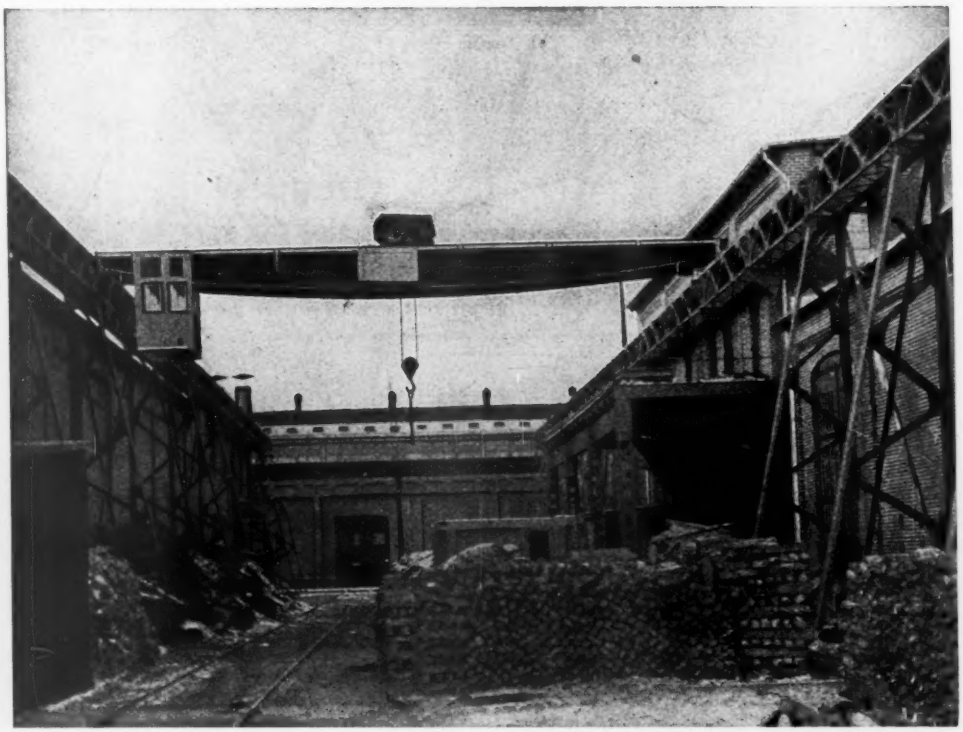

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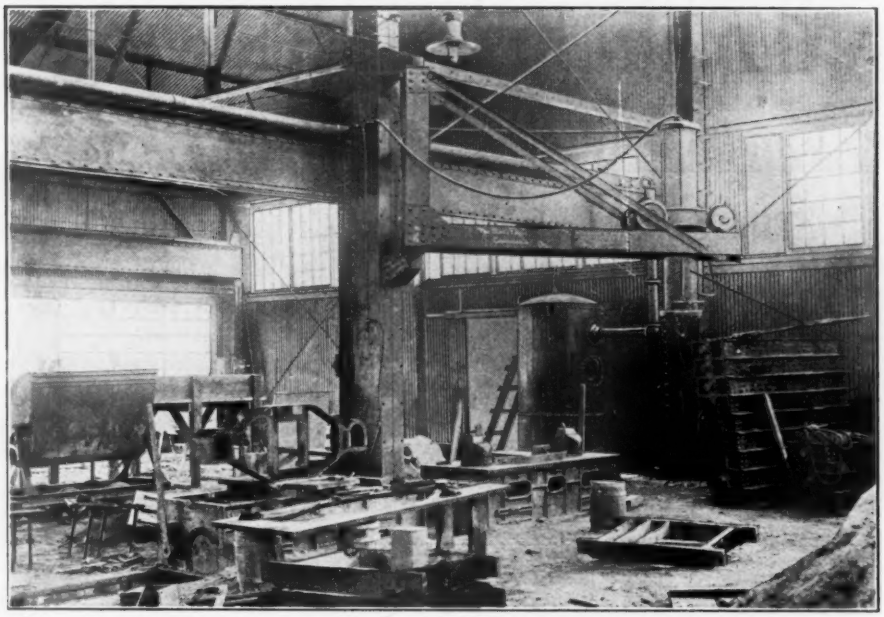
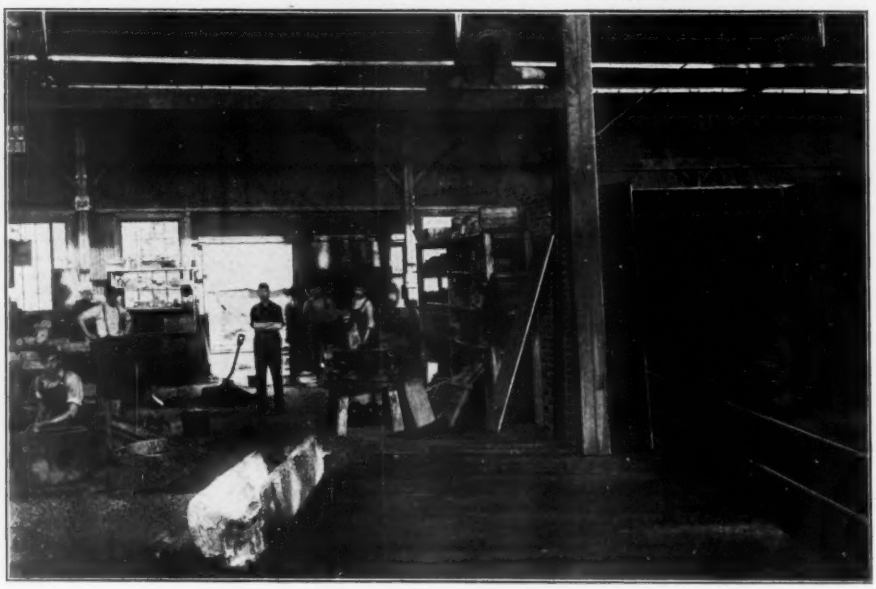


A Pair of Molding Machines With a Pneumatic Jib Crane.

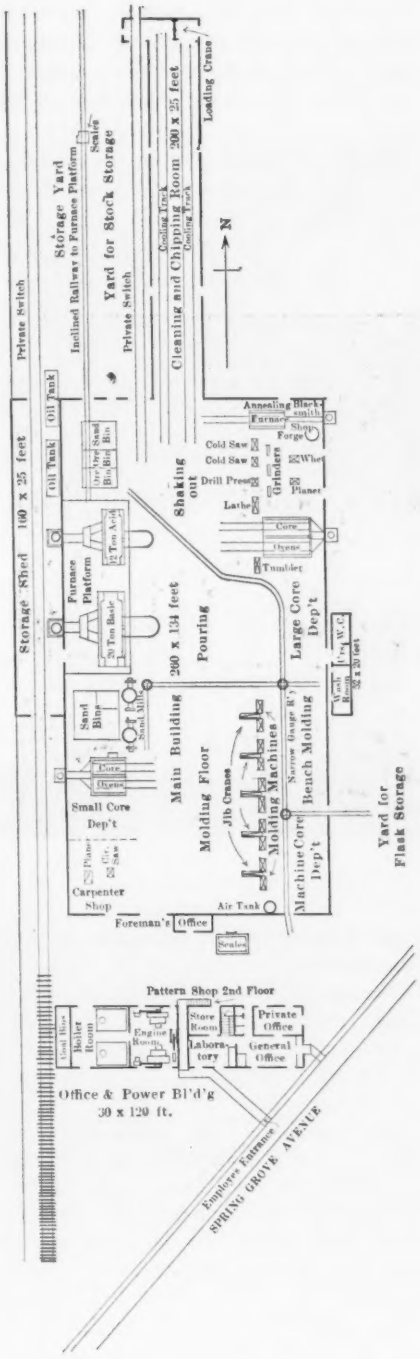
open-hearth process. These conditions certainly made the business venture an exceedingly attractive one, since the market already existed, with unusually favorable conditions for supplying the demand.

The construction work on the plant was started early in the spring of the present year, and it now consists of two buildings, one a two-story brick building, 30 x 90 feet, containing on the first floor the office, chemical laboratory, store



Core Department.

room and power house, and on the second floor the drafting room, testing laboratory and pattern shop. About 50 feet from the office building is the foundry proper. This is of steel construction covered with corrugated iron. The foundry building is 135 x 240 feet and is divided into three bays. The central bay is served by two Pawling & Harnischfeger traveling cranes, of 5 and 15 tons capacity, respectively, and 65-foot span. The west bay contains the furnaces, sand bins, core department and flask shop, while the east bay contains the annealing oven, cleaning department, machine shop, mold drying oven and the light work floor. The plant is equipped with an industrial railway system throughout.



PLAN OF WORKS.

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To begin with the raw material and follow the steel castings through their various processes will probably be the most intelligent method of treating the plant. At the north end of the works there is a large yard for the storage of pig iron, scrap, etc. The material for the furnaces is taken into the building by an incline, the cars on which are drawn up by an electric hoist. Between the furnaces and the end of the building are situated a series of bins for iron ore, furnace lining material, etc.

The furnace equipment consists of one 15-ton acid open-hearth furnace and one 20-ton basic open-hearth furnace. Both furnaces are of the stationary hearth type, and the checker work is situated beneath the furnace. Crude oil is used for fuel, the air only being passed through the checker work. The furnaces are charged by hand and the metal is tapped into ladles in the main bay of the foundry. At present a large number of wooden flasks are used for the special lines of work which are being manufactured, but in the future they will all be replaced by metal flasks.

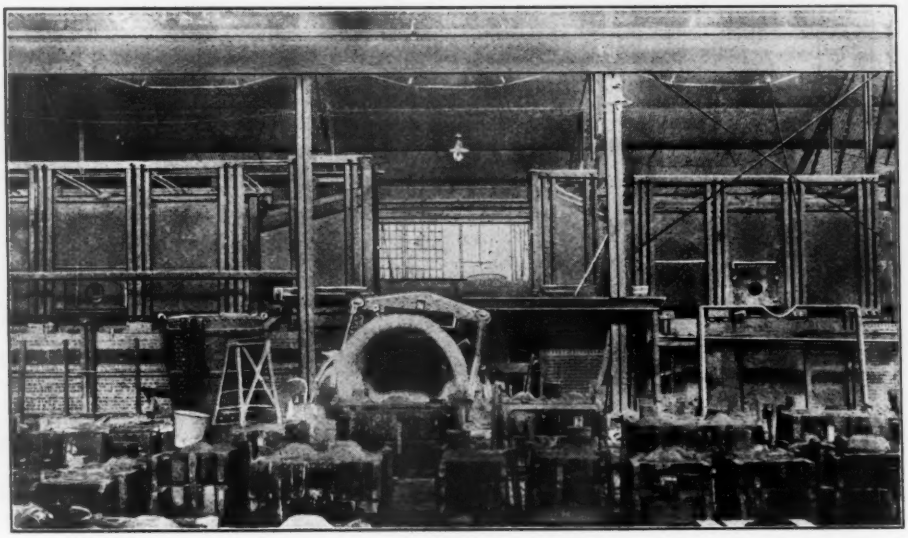
The molding sand is kept in a large bin at one end of the furnace, the capacity of which is 200 tons, the bin being filled from cars on the outside of the building. The sand is prepared by grinding in the usual manner. The core department is situated next the sand bin, and is of sufficient area to take care of the entire capacity of the plant. The core ovens consist of two large brick ovens, 8 x 8 x 16 feet, at the back of

which are arranged two Hill & Griffith ovens with swinging shelves.

In the southwest corner of the building, next to the core department, is located the flask shop. This is equipped with all of the wood and metal working machinery necessary for the construction of both wood and metal flasks.

All of the special molding and the larger work is done upon the floor in the usual manner. The duplicate work, which consists largely of car truck frames, is made upon molding machines, which are arranged along the east side of the central bay of the foundry. There pneumatic tools are used quite extensively. The plant is also equipped with cutting-off saws, lathes and drill presses.

The truck frames and some other classes of castings require annealing. This is accomplished by an annealing oven located in the northeast corner of the plant. The oven is 8 x 8 x 16 feet and is heated with crude oil. After the castings are removed from the annealing oven they are placed on a series of hot beds made up of railroad rails. The work can be slid out through the north end of the plant and left to cool upon



OPEN-HEARTH FURNACES.

are ten of these machines arranged in pairs, one machine forming the cope and the other the drag of the mold. Each pair of machines is served by a jib crane, with a 3-ton pneumatic hoist. These cranes were furnished by the Whiting Foundry Equipment Co., of Harvey, Ill. The cranes serve to place the flasks upon machines, remove the cope and drag portions of the mold, and assemble the same.

The most of the work made is molded in green sand and skin dried, and for the special duplicate work two large mold ovens, 9 x 9 x 21 feet, have been provided.

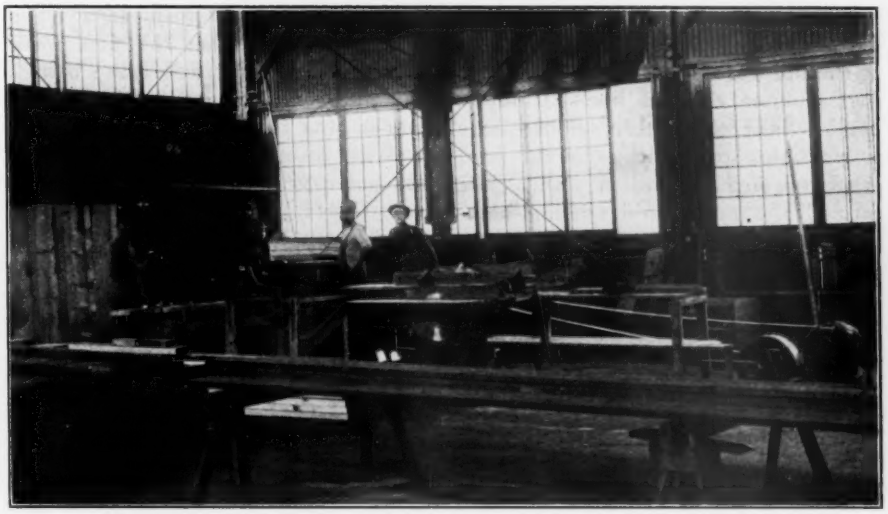
For finishing or cleaning the castings pneumatic chipping hammers or other these hot beds, which also serve as chipping stands.

The power equipment consists of two Geary water-tube boilers, a 200-horse-power engine which is connected to a 125-kilowatt generator, furnishing current at 220 volts.

For supplying the compressed air needed about the plant, a duplex 2-stage compound air compressor manufactured by the Laidlaw-Dunn-Gordon Co., is used. This compressor has a capacity of 1,000 cubic feet per minute, at 100 pounds pressure.

The heart of any steel foundry is, to a large extent, the laboratory, and this plant is provided with a remarkably well equipped laboratory. All of the neces-

sary apparatus has been installed and carefully arranged so that the work can be done rapidly and accurately. In addition to the chemical laboratory there is a testing laboratory for conducting physical tests. All of the raw materials, as well as finished product are analyzed and looked after by the chemist.



FLASK MAKING DEPARTMENT.

FOUNDRY ABUSES.

BY HARRY MALONE.

The way some things are misused or abused about the foundry is a caution, and we believe that many foundrymen think that the directions which accompany anything do not amount to enough to pay any attention to. The writer has seen many classes of foundry supplies which the average foundryman evidently wished to learn how to use by the process of elimination, in other words, he butted ahead and did it just as many wrong ways as he possibly could first, in the hope that he would finally strike on the right way. This certainly does not look like a money-making proposition.

One of the cases which recently came under the writer's notice was the abuse of thermit. A foundry foreman had purchased two cans of thermit for use in the ladle. First, he was curious to see what it was like, and as a consequence, opened the can, though the directions told him that it was not to be opened. In so doing, he loosened the ignition powder which was on the top of the thermit and which he could not tell from the thermit. He claimed that what he found was a composition composed mostly of cast iron borings, being unable to tell the iron oxide from cast iron borings. Thermit is simply a mixture of iron oxide and pure metallic aluminum. When the compound is heated high enough, the aluminum robs the oxygen from the iron, forming aluminum oxide and free iron, and the purpose of the ignition powder is to start this action. After the top of the can had been removed its introduction into the ladle produced no good results, and in fact, it was tested by pouring the powder from the can into the bottom of the ladle before the iron was tapped on to it. The temperature of the iron tapped into the ladle was not high enough to ignite the thermit without the ignition powder, and as the ignition powder had been lost in the process, or scattered to one side, there were only slight flashes but no general ignition, and the portion of the thermit on the bottom

of the ladle stayed there without igniting, thus resulting in a ladle skull, where it should have resulted in hotter iron.

This experimenter then took his remaining can and pressed it into the ladle in a proper manner and allowed it to ignite, but as soon as it ignited he commenced to jerk it up and down through the iron and finally lifted it out before the ignition was complete. A thermit reaction takes from one to two minutes and the can should be held as near the bottom of the ladle as possible, so that the thermit steel resulting from ignition will rise through the molten iron, stirring, heating and purifying the whole mass. The igniting of thermit on top of or near the surface of cast iron in the ladle only results in the loss of a large proportion of the heat into the atmosphere, and as hot metal always tends to rise to the surface of colder metal it will be found impossible to get the heat back down to the bottom of the ladle where it is wanted. Thermit is useful for a good many purposes, but in the gray iron foundry in most cases is simply an emergency remedy and should be used according to directions.

It would be just as sensible to think of changing the method of taking a doctor's prescription and then expecting to get results from it, as it would to change the method of using thermit, or in fact, any of the other foundry supplies or foundry materials which are now furnished to the trade. This specific illustration in regard to thermit applies equally well to the use or rather the abuse of foundry facings, core compounds, and special alloys, but there is enough in the latter statement to write an entire article sometime.

THE ELECTRIC CRANE IN THE FOUNDRY.*

By Harry Sawyer.

It is not the purpose of this paper to enter into a technical discussion of the electric crane, but such a presentation of the subject as will lead to a better understanding between makers and users cannot fail to be mutually profitable.

The use of the electric crane in the foundry doing heavy work has become so general that even a reference to the older methods, by way of comparison, seems uncalled for.

It may be interesting, as a bit of history, to note that the first three-motor electric traveling crane built in the United States, and probably in the world, was for use in a foundry. It was put in operation only a little over seventeen years ago. Although it was constructed from the wreck of an old rope-driven crane, it did good service night and day for nearly ten years. It was the invention of Alton J. Shaw, then employed by the E. P. Allis Co. as a designer, and was used in the foundry of its Reliance works, at Milwaukee.

There have been some interesting phases in the development and introduction of the electric crane. The skepticism of those in need of such machines, and the opposition of those engaged in the manufacture of the earlier types, was to be expected; but it is only fair to say that the users of cranes were quicker to recognize the advantages of the new type and to adopt it, than were the makers of the old.

The use of the electric motor and the sliding contacts, solved in so satisfactory a way the problem of transmitting power to a moving machine, that the traveling crane rapidly superseded the swinging crane in nearly all classes of foundry work where a crane is required. In one notable instance,—pipe foundry work—the swinging crane was retained. Whether this was due to some peculiarity of the work that made the circular pit and the circular movement essentially better than the rectangular pit and corresponding crane movements, or whether it was due to the natural persistency of established practices, seemed for a time to be an open question; but the recent equipment of several pipe foundries

*Read at the A. F. A. Convention, Cleveland, June, 1906.

with traveling cranes, indicates that the latter was the correct explanation.

It is no doubt true that the foundry has set the standard of excellence for electric cranes. Some shops and mills may have heavier loads to handle and require greater speed, but the crane manufacturer recognizes that the perfect control required in the foundry, represents a higher state of development than mere requirements of capacity and speed. It should not be understood that good control is not required in mills and shops, particularly the latter, but as a rule the requirements of the foundry are much more exacting.

The conditions under which a foundry crane is operated, are less favorable to continued good service than the conditions in a machine shop. It is more subject to overload, and the dirt and dust necessitate more careful attention; furthermore, the men directly responsible are usually less familiar with machinery, with the result that the crane too often does not have the care that it should. It is a mistake to assume that a crane which does the work of an army of laborers, can safely be handled and cared for by one of that class. The importance of employing only thoroughly competent and conscientious operators, and keeping the cranes in perfect repair cannot be too strongly urged. Prompt attention will reduce the total cost of repairs and the extra cost of careful and competent men, will be saved many times in the more constant service and longer life of the crane.

There is at the present time something of a demand for excessively high speeds, and the motives of the manufacturers who advise against them, are sometimes misunderstood. It is not that the problem presents any difficulties from the manufacturer's standpoint. He may prefer to furnish a standard article, from considerations of cost and delivery, but oftener he is considering the direct benefit to the customer and the indirect benefit to himself. The manufacturer and user may recognize the same advantages, and disadvantages but from their different standpoint, they do not see them in the same proportion.

The one advantage sought in high speeds is a saving of time, but this is often overestimated. Take for example a 10-ton crane with full load speed of 20 feet per minute. We may assume that the average load will not be more than one or two tons, that the average speed for such load will be 30 feet per minute, and that the average lift is five feet. Allowing 50 per cent more time for acceleration from a state of rest, and we find the time for an average lift to be 15 seconds.

If the speed of hoist were doubled, it would at first appear that one-half of this time, or 7½ seconds, would be saved. If 20 lifts were made per hour, the result would be a saving of only about four per cent of the time. When it is remembered that many of the lifts must be very slow, regardless of what the crane is capable of doing, and that traverse movements are usually started as soon as the load is clear of surrounding objects and before the hoist movement is stopped, the actual saving is reduced to a very inconsiderable amount of time.

Where a large floor area is covered, a greater saving can be made by increasing speeds of horizontal movements, but the swaying of load which results from high speeds and sudden starting and stopping, sets a limit to the saving that can be made in this direction.

Two objections may be offered to excessively high speeds. First, the accidents that are likely to result from putting a high speed crane in the hands of an incompetent operator often cause the loss of much more time than is saved by the higher speeds, and greatly increase the cost of repairs. Second, if the crane is not usually run at full speed, there is a constant loss of power in the rheostat, and unnecessary wear and tear on the controller parts, both of which cause expense and loss of time. The above comparisons apply with the most force to cranes in foundries, and with least force to cranes in mills where much

higher speeds are necessary and practical.

Next to the requirement of necessary strength in all parts for absolute safety, the most important point to be considered is perfect control of the hoisting mechanism. This depends upon three parts; the motor brake, the load brake, and the controller.

The motor brake is released by the current which operates the motor, and should require only as much current as is necessary to drive the machinery without load. It should be sufficiently powerful to bring the armature to a stop promptly, but without shock, when the current is interrupted.

The load brake is a far more important part. It must allow the machinery to run freely in hoisting, but prevent the load from descending, except when the motor is run in the lowering direction. In most, if not all forms of load brakes now in use, the brake is applied by the action of the load. They may be divided into two classes: one in which the brake pressure is not reduced in lowering, but the motor acts with the load to cause the brake to slip; and the other in which torsion of the motor in the lowering direction reduces the pressure between the surfaces, allowing the brake to slip and the load to descend. The most common of the first class is the enlarged step bearing on a worm shaft. It can be used only in connection with worm gearing. It is a very simple and may be made a very satisfactory working brake. The most serious objection to it is this: If proportioned to give a fair margin of safety with the best conditions of lubrication, it will take considerable power to lower with moderate or poor lubrication, for the motor must overcome any excess of holding power over that necessary to sustain the load. This extra work in lowering means loss of time and power, and greater wear of parts.

Of the second class, there are two types: the coil type and the disc type. Both have their advantages and disadvantages. The disc type is more substantial in construction, gives better distribution of pressure over the friction surfaces, and consequently a much lower unit pressure; and as the pressure is strictly in proportion to the load, it gives higher speeds in lowering light loads. It has this disadvantage, that it is more sensitive to irregularities in lubrication.

In the coil brake the pressure and wear are concentrated principally at one end. While the brake is applied by the action of the load, the pressure and resistance to slipping are not strictly in proportion to the load. The torsional effort of the motor to release the brake is dependent upon the proportions of the brake parts, and not upon the load, hence the speed in lowering is approximately the same for all loads.

Both types are used by reputable builders, and both may be designed to give good results.

A good controller is indispensable to a satisfactory crane. The essential parts of the controller are the resistances and the means for varying the amount of resistance in the circuit, according to the speed and power required. The most common practice is to divide the resistance into sections, connect the sections together in series and connect each section to one of a series of corresponding contacts. A brush is arranged to pass over those contacts, cutting more or less of the resistance into or out of the circuit. Various materials may be employed and details used to obtain the desired result, but certain conditions must be complied with if satisfactory results are to be secured.

The total resistance may be sufficient to allow the passage of only enough current to start the motor at a very slow speed with its smallest load. The number of sections must be sufficiently great and the resistance of these sections sufficiently small that no sudden or abrupt changes of speed will occur from the time the first contact is closed, sending the current through the resistance, to the time that all the resistance is cut out,

and the motor is given full current.

Durability of the controller and convenience in making repairs, are important considerations. The construction should be such that neither the resistance material or the supporting insulation will be injured by the heat. Conservative rating and good ventilation are required to keep the temperature down to a safe point. Sparking and burning of contacts cannot be entirely prevented, but proper proportion of resistance to avoid great changes in voltage between consecutive steps, and a well designed magnetic blowout will prevent serious burning. The brushes and contact pieces must be renewed occasionally, and they should be very accessible. It is important also that the resistance material should be removable without moving the controllers from their positions in the operator's cage. Economy of space, so far as it is consistent with proper sizes of parts, good ventilation, good insulation and accessibility is of importance.

Crane motors are usually series wound. It seems almost unnecessary to say that they should be very simple and strong mechanically, that the electrical insulation should be of the best quality and that they should be designed to stand great variations in speed and load, and sudden reversals under load without injurious effects. The highest possible efficiency at some one speed and load is not so important as a good average efficiency over a wide range. Motors of low or moderate speeds are preferable on account of the reduced gear ratio required between motor and winding drum or driving wheels.

Referring in a more general way to the design of cranes and the problems and limitations met by the designer, it is the exception rather than the rule, that he has free hands to do as he might wish. Limited space; close approach of hook to roof, sides, and ends of building; perfect accessibility of all parts; a large factor of safety; low price,—these are some of the requirements which, desirable as they may be, are not always compatible.

Manufacturers and users have underestimated the advantages to both of getting together. The manufacturer should understand fully the requirements of the user, and the user should know the full effect of the limitations he places upon the manufacturer.

GENERAL INDUSTRIAL NOTES.

The new plant of the Arcade Malleable Iron Works, Worcester, Mass., which is known as the Worcester Malleable Iron Co., has been in operation since Aug. 15. The company now employs in its two plants about 194 molders. Frank S. Chipman is general manager, and A. R. Porter, formerly superintendent of the Lakeside Malleable Iron Works, Racine, Wis., and the Chicago Hardware Co., North Chicago, Ill., is superintendent.

The Pressure Casting Co., 1122 Whitehall building, New York city, has been incorporated to manufacture metallic castings. The authorized capital stock is $10,000 and the incorporators are C. G. Armstrong, O. E. Goldsmidt and E. L. McElaine.

W. W. Wilson has purchased the foundry building situated on the Josephus Clark property in Jamestown, N. Y., and will continue its operation.

The Carborundum Company, of Niagara Falls, is now constructing a large works at Reisholz, a manufacturing suburb of Dusseldorf, Germany. The European business will be carried on under a new company, which was organized for the purpose, known as "Deutsche Carborundum Werke, G. m. b. h." The plant will also be equipped with all necessary appliances for the manufacture of abrasive wheels.

The Reading Steel Casting Co., Reading, Pa., is now operating the plant formerly occupied by the Brylgon Steel Casting Co., and is especially equipped for the production of small, intricate steel castings by the Tropenas process. The company now has about 100 men in its employ and is producing about 150 tons of steel castings a month.

BRASS FOUNDING

THIS DEPARTMENT IS DEVOTED TO THE TREATMENT OF ALL ALLOYS INCLUDING THEIR

FOUNDING, GRINDING, POLISHING, ELECTROPLATING ETC.

PRACTICAL ALLOYING XI.

The Properties of Alloys.

By John F. Buchanan.

The properties which contribute to the general usefulness of metals are: Hardness, tenacity, elasticity, malleability, ductibility, density, fusibility, expansion by heat, resistance to corrosion and conductivity for heat and electricity. These properties always show some variation from the mean when two or more of the metals are combined to make an alloy. In view of the great uncertainty as to the chemical condition and behavior of fused metals with one another, it would be impossible to lay down propositions covering the general results of alloying. Every new alloy is an experiment, because the manner in which a metal affects or is affected by metals with which it may be mixed, cannot be exhibited in advance. For the most part the chemical properties of the metals are latent and the physical properties of the alloys depend upon the chemical conditions.

Nearly all of the elements exist in a state of combination in nature, but for the uses of engineering it is necessary to separate and recombine the metals to produce alloys giving constructional advantages. The principal objects of alloying metals are: (1) to increase desirable qualities as strength, hardness, toughness, or elasticity. (2) To lower the melting point. (3) To modify the color of structure. (4) To facilitate the production of sound castings. (5) To resist corrosion. (6) To economize materials. Hence, there is a growing tendency to group alloys by their predominant physical properties — as (1) high-tension alloys, (2) fusible metals, (3) decorative alloys, (4) deoxidized metals, (5) non-corrosive alloys, and (6) light alloys and anti-friction metals.

Of the seventy-odd elements which have been isolated by the chemists, only some twenty possess properties of value in the production of commercial alloys. These are: Copper, zinc, tin, lead, antimony, aluminum, nickel, bismuth, cadmium, magnesium, iron, manganese, chromium, gold, silver, platinum, arsenic, phosphorus, silicon, mercury.

Carbon is an essential element in cast iron and steel and its alloys, but the conditions and effects of carbon in these metals and the use of the rare metals molybdenum, vanadium, titanium, etc., in the manufacture of special steels, are outside the scope of this work which purports to treat of the alloys in general use for castings. Besides, carbon is inert at the lower temperatures required for alloys in general. The great majority of the useful alloys are combinations of two or three metals, and the order in which the metals are stated above is approximately the order of their usefulness from the viewpoint of the foundryman and the engineer.

The alloys of a given metal may be divided into two classes, viz.: (1) those in which the metal is the chief constituent, and (2), those in which it is present as a necessary constituent. For example, Tier's argent is an aluminum-silver alloy which is harder and easier worked and engraved than most other silver alloys, and it consists of aluminum two thirds, silver, one-third; on the other hand, aluminum bronze is an alloy of the second class, showing copper 90

to 97 parts to aluminum 3 to 10 parts. But for the present we are more concerned with the physical properties of alloys than with their composition.

Hardness.—The property which is most generally conferred by alloying one metal with another is hardness. The hardness of an alloy is very much affected by the rate of cooling as well as by the presence of impurities in the metals, but the relative hardness of the alloying metals gives no clue to the hardness or the fracture of the alloy. The following figures give the rates of hardness for some metals and their alloys: Lead, 7, tin 13, zinc 70, aluminum 89, copper 106, antimony 160, antimonial-lead 12, babbitt 18, brass 164, hard bronze 244, phosphor bronze 253.

Mechanical treatment, such as rolling, hammering, etc., hardens metals by changing the molecular condition, but when such metals are remelted they assume the normal hardness and structure on solidification. Nickel and manganese are the hardest metals entering into ordinary alloys; but some comparatively soft metals have remarkable hardening powers, such as, zinc in aluminum alloys, tin in copper alloys, or lead in gold alloys. The metalloids arsenic, silicon and phosphorus are also powerful hardeners. By combination in certain proportions with silicon, the hardness of steel is imparted to copper. With a greater or smaller quantity of silicon the properties of the alloy vary, the high silico-copper being a capital deoxidizing agent, while the low silicon alloys possess great elasticity and power of resistance to heat, and they conduct electricity better than any other alloys.

Another splendid example of the hardening effect of one element on another is seen in the modern alloy meteorite, or phosphorus-aluminum. In this case, as in most others, the increased hardness is not the only beneficial effect procured; better casting and working qualities accrue, and, speaking generally, crystallization is modified, the tensile strength is improved, sonorousness is increased, and a closer grain in the metal gives it a finer luster.

Fusibility.—Another general result of alloying metals is to render them more fusible. With very few exceptions the melting points of alloys are below the mean of the metals used, sometimes they are even more fusible than the most fusible component, as for example, the so-called fusible alloys containing bismuth. The influence of heat on metals and alloys is a most interesting study. The extreme temperatures necessary in modern industries have developed a new field of metallurgy which promises to reveal many dark things concerning the resistance of refractories and the chemistry of high temperatures. None of the metals can resist heat or chemical action. The electric furnace is producing today many substances which offer enormous advantages over the products available at ordinary furnace temperatures. The immediate effects of heat upon metals and alloys vary considerably. Besides the difference in the degrees of heat necessary to reduce them, the metals show considerable difference in their behavior in the heat and on cooling down to ordinary temperatures. Some of them soften or become pasty, before actual fusion occurs, others pass directly from the solid to the fluid state and vice versa, while one, arsenic, passes when heated directly from the solid to the gaseous state without becoming liquid. It can only be liquified under pressure. All metals are volatile to a greater or less extent but the critical degree of heat at which some of them (as manganese, platinum, chromium) vaporize is beyond the power of the ordinary furnace.

Whenever there is a chemical union of the elements in an alloy heat is liberated. Generally there is a marked increase in the temperature and also in the fluidity of the metal. The reaction of metals which melt at

very high temperatures are not so easily controlled, therefore it is customary to make alloys requiring high temperatures by some intermediate process, say by reducing the oxides in the presence of some other substance possessing affinity for oxygen. Similarly, for the union of metals which volatilize readily, as zinc or antimony with metals requiring high temperatures for their fusion, as iron, or nickel, the direct method of mixing is always unsatisfactory. Fortunately the chemical affinity of the metals admits of correct combinations being made at temperatures slightly higher than are necessary to melt the less refractory metals. Thus, iron may be alloyed at the temperature of molten zinc. Copper may be dissolved in molten tin, nickel is easily reduced in a bath of copper and platinum is attacked immediately it is heated in contact with lead, or one of the metalloids, phosphorus, silicon or arsenic. These examples prove the common rule that alloys are more fusible than the fusibilities of the several metals would lead you to expect.

To sum up, heat has a tendency to destroy cohesion; within certain limits it causes expansion proportional to the degree of heat; it lowers the tensile strength of most alloys and it affects the mechanical properties of different metals in different ways as evidenced by the various methods of working them in forging, welding, tempering, rolling, drawing, stamping, spinning, soldering and casting. Further, the action of gases on molten metals interferes with their molecular arrangement and hinders the formation of homogeneous alloys. At high temperatures the gases are more active and the metals are more easily permeated by them; it is always a wise precaution, therefore, to alloy the metals at as low heats as practicable. The alloy may afterwards be raised to the proper heat for casting, with better prospects of retaining the exact proportions and characteristics desired.

Density.—The majority of the useful metals are between seven and eight times heavier than an equal bulk of water. Density, or specific gravity, is used as a term of comparison expressing the relative weights of equal volumes of different substances, and the metals are generally compared to the space occupied by

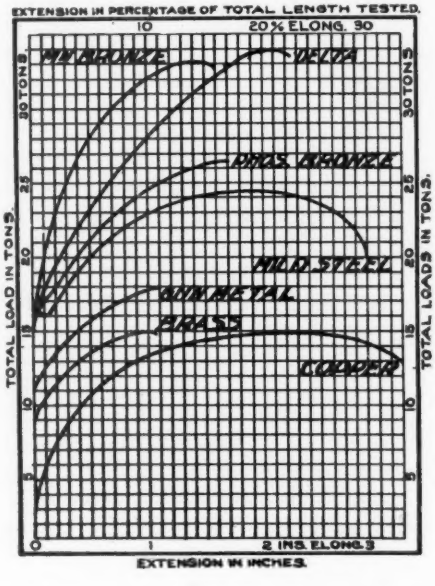


FIG 1.

1 c. c. of water at 0° Cent. No body is perfectly dense so as to have no interstices, or be destitute of pores, but the density of metallic substances may be considerably increased by mechanical treatment. The specific gravity of an alloy is sometimes greater and sometimes less than the mean of its components. When the density is increased contraction has occurred and chemical combination has probably taken place; but when the density is lessened it shows that there has been a separation of the particles in the process of alloying conditioning the expansion of volume. With the exception of bismuth, all metals are denser in the solid than the liquid state. As a rule alloys are heavier than their calculated specific gravity, but a curious exception is the

alloy containing aluminum 18.87 per cent and antimony 81.13 per cent. Its theoretical specific gravity is 5.225, which is the density it would have if its components combined with no contraction or expansion of volume. Its true specific gravity is 4.218. This shows a large expansion of volume during alloying which is clearly illustrated by the following figures: 7.07 cubic centimeters of aluminum alloying with 12.07 cubic centimeters of antimony, produce 23.71 cubic centimeters of alloy. This alloy is also an exception in the matter of fusibility. Antimony and aluminum both melt in the region of 600° Cent. yet the alloy does not melt below 1,080° Cent.

Working Properties.—At this point we notice some of the working qualities of the metals and alloys. The leading characteristics of the metals are malleability, ductility and tenacity. The usefulness of metals and alloys depends to a great extent upon their classification (high or low) under these three headings. Of course, for castings, tenacity is always the most important property; cohesion is the first desideration in cast pieces and a high tensile strength combined with toughness and elasticity ranks the metal or alloy well up in the list of useful structural materials. The relative strengths and the toughness of some important copper alloys are graphically depicted on the accompanying diagram, Fig. 1.

When metals are mixed together to form alloys changes occur in the structure and physical properties of the product. Indeed, the modified properties of alloys are often of greater practical value than the independent use of the simple metals. The properties of alloys are widely different from the ratios of the combining metals. Copper and lead are both highly malleable but the alloy known as pot metal is not so; copper and tin are comparatively soft, yet the alloys bell metal and speculum are harder than steel; iron and nickel are both highly sensitive to the action of a magnet, but ferro-nickel (25 per cent Ni) is practically non-magnetic. Alloys of copper and zinc are more ductile than copper; alloys of aluminum and tin are less ductile than aluminum. From these examples it may be judged that the relative properties of the metals do not continue in their alloys. Further, given the properties of a definite alloy, the effects of introducing even a trace of a foreign substance into it could not be foretold by any reasoning from analogy.

As a rule metals of similar character unite to form comparatively weak alloys and only where the constituent metals show great dissimilarity in properties do we get alloys that are united by the strong bonds of chemical affinity.

Fracture.—The workability of metals and alloys depends largely upon their structure. Brittle metals show a feeble resistance to dynamic tests and they must be sparingly used in alloys that require to have good mechanical properties. Combinations of antimony and bismuth, bismuth and zinc or antimony and zinc are on that account useless in the arts.

The mechanical value of structure in metals may be illustrated by the changes produced by increasing the content of a given metal in an alloy, zinc in copper for example. Beginning with pure copper we have the highly malleable and ductile qualities shown in the silky and finely fibrous fracture of the metal. By adding zinc up to forty per cent the metal assumes different structures at various stages. With ten per cent zinc the fracture is coarsely crystalline, with twenty per cent it is finely fibrous; at 30 per cent it is granular and it becomes more finely granular with additional increments up to 42 per cent. Meanwhile the tensile strength of the metal has steadily risen from 27,800 lbs. to 51,000 lbs. per square inch. Beyond the 40 per cent limit, ductility extensibility and strength decrease

and at zinc 60 per cent the fracture is vitreous conchoidal, with a tensile strength of only 3,727 lbs. per square inch. Metallic fractures have been classified as:

Crystalline.—Metals presenting this appearance are weak, as rupture occurs by the separation of adherent facets. Examples, antimony, zinc, bismuth.

Granular. — This fracture resembles sandstone. The high-tension alloys of modern times are all finely granular. The principal features of this structure are homegeneity, cohesion and "flowing" power.

Fibrous.—The strongest and most readily worked of all metallic structures. Wrought iron is a good example of this fracture.

Conchoidal.—Metals possessing this fracture are hard, highly elastic and brittle. Example, bell metal.

Columnar.—This appearance is presented by some metals when they are broken hot. The metal has a tendency to separate in long fingers across the thickness of the ingot. Example, tin.

It is a common occurrence to find two or even three kinds of fracture in a single specimen of an alloy like yellow brass, or German silver: usually the granular and the fibrous, and the granular and finely crystalline structures are associated with each other.

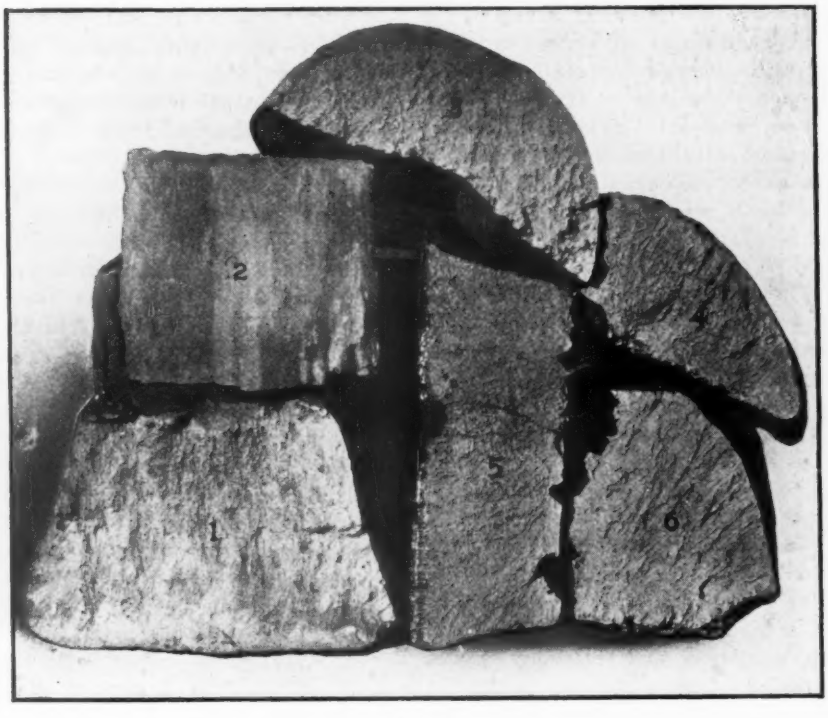


FIG. 2.

Of course it is the aim of the founder to produce a metal of uniform structure, but metallography has revealed the fact that alloys, even when they are apparently homogeneous, present compound structures, and in many cases the direction in which the different forms merge and settle contributes to their efficiency. Generally the more rapidly a metal is cooled from the molten state the more regular the fracture when it is broken cold, the reason being that there is less time for impurities and segregating elements to gravitate towards the

surface or the center of the mass. We do not recommend judging the value of metals, especially alloys, by the fracture. It is well known that different treatments impart different properties to metals having the same composition. Fractures vary with the temperature and the manner in which the rupture has been produced. An ingot of yellow brass broken between supports at 60° Fahr. will present a granular appearance, while the same ingot broken at 600° Fahr. exhibits a fibrous fracture, as at No. 6, Fig. 2. Another example of a hot break is No. 2, the columnar structure, procured by heating an ingot of plumbers' soft solder and striking it sharply with a mallet. No. 3 is an aluminum zinc alloy and the fracture is somewhat crystalline. The bronzes afford the best examples of granular fracture, Nos. 5 and 7 are manganese bronze and phosphor bronze, respectively. As showing the typical fractures of copper-tin alloys with increasing proportions of tin No. 8 (coarsely granular) is a sample of the standard gun metal (9 and 1 alloy), No. 4 is a hard railway gun metal (7 and 1 alloy), and No. 1 is a speculum alloy (2 and 1) used as a "hardening" for babbitt metals. This fracture is highly conchoidal and the metal is brittle as glass and harder than steel. The tests which are sometimes made by gripping the metal on trial in a vise, and observing the angle through which it bends, or the number of blows required to break it, can only give the roughest idea of its capabilities. To get the true history and constitution of the metal a closer examination and more accurate measurements are necessary.

The two factors which determine the condition of alloys are their chemical composition and their physical structure. Chemistry reveals the former and metallography, the science which has lately shed so much light on the microstructure of metals, interprets the condition and the limitations of the latter.

Conductivity.—All metals are good conductors of heat and electricity. Their relative conducting powers according to Matthieson and Franz and Weidmann are given in Table 1:

TABLE I.

	For Heat.	For Electricity.
Silver	1,000	1,000
Copper	748	941
Gold	548	730
Aluminum	.....	511
Zinc	.....	266
Platinum	94	166
Iron	101	155
Nickel	.....	120
Tin	154	114
Lead	79	76
Bismuth	18	11

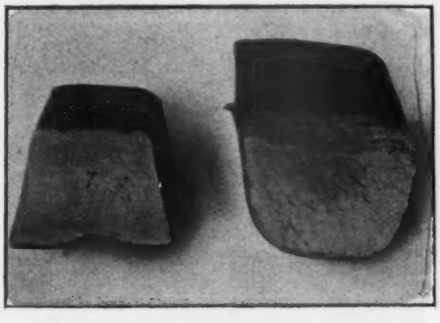


FIG. 3.

Electrical conductivity is greatly diminished by a rise in temperature as well as by impurities in the metal. Alloys as a rule are very poor conductors and on this account the metals which occupy the lower positions in the foregoing table are best suited for resistance coils, etc. The Cowles company prepare white alloy of copper 67.5 parts, zinc 13, manganese 18, aluminum 1.20 and silicon 0.5, the electrical resistance of which is about 48 times that of copper and 37 times that of the standard German silver, considerably greater than that of any other material known which is capable of being drawn into strong, tough wire.

The resistance of alloys is not affected by changes in the temperature to the same extent as the pure metals, on the other hand the purity of the metals, silver, copper, aluminum, etc., may be tested, and impurities de-

tected by the diminished transmission of electric force. This is the latest tell-tale for adulterations or impurities in new metals. Owing to the presence of oxides, or to the fact of their being melted in contact with the fuel, cast metals (copper or aluminum) have not the high conductivity of electrolytically or chemically prepared metals.

Summary.

Alloys generally have properties differing (in kind and degree) from their constituents.

Some metals alloy freely in all proportions and present few difficulties in working. (Examples, silver and copper, copper and zinc, tin and lead), while others, like lead and aluminum or zinc and lead, cool out in layers.

You cannot calculate the physical properties of an alloy from the physical qualities of the respective metals; small additions sometimes effect enormous changes.

Alloys of brittle metals are always brittle, but the other qualities of metals do not continue in the same manner.

The fracture is an index of the condition of an alloy at the time of rupture, but the same alloy when remelted may be unworkable and when it is again ruptured the structure may be totally different owing to heat treatment.

GENERAL VIEW OF ONE HALF OF FOUNDRY FLOOR. NOTE.—THE LARGE CASTING LEANING AGAINST THE WALL IS A N ALUMINUM CASTING WEIGHING 750 POUNDS.

BRASS FOUNDRY DEPARTMENT OF THE BULLOCK ELECTRIC MFG. CO., CINCINNATI, OHIO.

This department turns out from 40,000 to 50,000 pounds of castings per month, and it is necessary to produce a large variety of work, including brass, bronze and aluminum, also various special alloys. The foundry at present employs about sixty men. A large proportion of the molds are put up on Tabor machines, which are situated at one end of the foundry, the molds being carried back and arranged in rows down the length

STEEL HARVEY MELTING FURNACES.

of the floor. The sand tempering and mixing machinery is arranged in the center of the room. The cleaning department is also located in the center. This places the molding floors on the sides nearest the windows where the best

CRUCIBLE FURNACES AND CORE DEPARTMENT.

of light is obtained. A trolley track is arranged over the floor where the heaviest work is made for handling both molds and metal. The cleaning department is equipped with metal band saws and all of the other machinery necessary for cleaning the castings. A large proportion of the castings made are very light and intricate in form so that the number of pounds produced is but a small indication of the amount of work necessary to turn them out. This is especially true of the bench work and floor molding.

A large amount of aluminum castings is turned out and in one of the pictures a very large casting is shown against one of the walls between two windows. This casting weighed over 700 pounds and was some 12 feet in diameter. Most of the metal is melted in a battery of four Monarch oil furnaces which are fired with crude oil. Mr. Arthur McDonald, the foreman, states that they have no difficulty whatever in melting aluminum or any of their other alloys in furnaces of this type. For special alloys a battery of seven crucible furnaces is provided. Back of the crucible furnaces there is a core oven which is heated by the waste heat from these furnaces. The core department is also situated back of these furnaces, so that the cores can be placed in the oven as soon as they are finished.

BRASS FOUNDRY NOTES

BY C. VICKERS

USE OF MODELING CLAY.

C. VICKERS.

An exceedingly handy thing to have in a brass foundry is composite modeling clay. This is a substance closely resembling ordinary clay in appearance, but unlike common clay which dries, shrinks and cracks, composite clay always remains moist and plastic. It is a combination of sulphur with fats and contains no water. It never hardens or decomposes and is always ready for use.

It is used by sculptors and modelers for executing small and intricate subjects, as its non-drying properties permit of the work, being laid aside for indefinite periods, to be resumed when convenient.

Its greatest value to the brass founder lies in the ease with which it may be applied to patterns, as it may be laid on like putty and smoothed over, a slight dusting over with lycopodium or other good parting, is all that is necessary to prepare it for the sand. When it must remain on the patterns for a considerable time, it should receive a coat of shellac. This hardens the surface and does away with the use of any parting. Minus the shellac, however, it leaves the sand perfectly clean and adheres to the patterns in a surprising manner, and still is very easily removed, all that is necessary being to loosen the clay from the pattern at one point, and peel it off. It often happens that corners on patterns that ought to have been filleted by the patternmaker are left sharp, so the molder has to round them off. This may be avoided by putting on a fillet of clay, which can be removed when the job is "out." Broken castings used for patterns in emergency jobs, can be fixed up so that they will leave the sand quite comfortably by a judicious use of modeling clay.

The price of the clay is 25 cents per pound, and it may be procured from any large dealer in artists' materials.

WHITE METAL PATTERNS.

C. VICKERS.

The white metal pattern is a very useful thing in brass founding, as it is the easiest way of duplicating a pattern.

Some customers seem to think that brass castings grow like gooseberries, on bushes, and all they need do is to provide a pattern and hand it in to the founder with a rush order to get all the castings they need without delay. To oblige this customer the founder must call to his aid the white metal pattern. Several molds are made from the solitary pattern provided, and poured in white metal, these castings are cleaned with knife, file and scratch brush, and in a very short time, a half dozen castings are "growing", where only one

would have grown without the white metal patterns.

White metal is used for such patterns because it permits of easy finishing.

The kind of white metal will vary with the pattern.

For little chunky patterns antimonial lead fills the bill. To make this, melt ten pounds of soft lead, bring to a red heat, and add two pounds of antimony, stir well, remove from fire, and add ten more pounds of lead, making 20 pounds of lead in all. The reason for melting only half the lead, is because the lead bath must be brought to a red heat, to dissolve the antimony, the addition of the balance of the lead now cools the alloy and prevents excessive oxidation.

It never pays in my opinion to make permanent patterns of white metal. When there is machine work to be done on patterns, brass only should be used. To put an expensive finish on a white metal pattern is throwing pearls before swine.

With regard to shrinkage, all white metals shrink, but not as much as brass. Shrinkage can often be provided against by a judicious rapping of the pattern before lifting off the cope. There are many patterns, however, on which the slight shrinkage incident to duplicating in white metal is immaterial. Such patterns can often be "gated" by the molder to great advantage. This "gating" is merely casting the pattern on a gate, which is then given no more than a necessary finish, and is ready for molding like any other gate of patterns.

Brass is not suitable as a material for such "hand-me-down gates", because it is difficult to finish. If a gated set of patterns are worth making in brass, there is only one method worth while, and that is the usual one of casting the patterns separately, finishing to size and riveting and soldering to their gate.

The gate we are considering, however, is not worth this expense, so our first step is to make a lot of individual white metal patterns,—as many as we figure putting on the gate,—we then arrange them in their proper positions on either side of a gate-stick and make a mold. After withdrawing the white metal patterns, it may be necessary to "bed" the original pattern in each of the white metal pattern impressions, and thus avoid double shrinkage. The gates are then cut, great care being taken in finishing the mold to make it as perfect as possible; also nails may be placed and cast in the gate for steady pins, when the mold is closed and poured. Antimonial lead is not suitable for such gated patterns, because they would break off from the gate, and undo all the work so carefully done. No regular white metal alloy can be depended upon for this job, lead and tin, alone are both too soft. I generally use an alloy composed of two pounds antimony to 12 pounds tin. This is costly, but when the gate is out of commission the metal can be returned to stock. The patterns are hard enough to hold their shape, and stand lots of abuse; soft enough to scrape up easily, and sufficiently ductile to never drop off their gates.

The Link Belt Machinery Co., of Chicago, has purchased the plants and assets of the Ewart Mfg. Co., of Indianapolis, Ind., and the Link Belt Engineering Co., of Philadelphia, and the company formed by this consolidation will be known as the Link-Belt Co. It controls three splendidly-equipped plants at Chicago, Indianapolis and Philadelphia, and the line of manufacture covers the whole field of conveying, elevating and transmission machinery, malleable and machine-made driving chains. The officers of the company are as follows: James M. Dodge, Philadelphia, chairman of the board; Charles Piez, Philadelphia, president; Glenn G. Howe, Indianapolis, first vice president; Staunton B. Peck, Chicago, second vice president; S. Howard Smith, Philadelphia, treasurer; P. G. Reid, Philadelphia, assistant treasurer; Dyke Williams, Chicago, secretary; Edward H. Burr, Philadelphia, assistant secretary.

THE PATTERN SHOP

SAVING FLOOR SPACE.

By H. J. McCaslin.

When it is necessary to cast a considerable number of large steel castings from special heat which requires practically all of the metal from one charge of an open-hearth furnace, the question of floor space for the large molds is often an important one and the foundryman frequently finds himself in a quandary as to the best method of getting out of the difficulty.

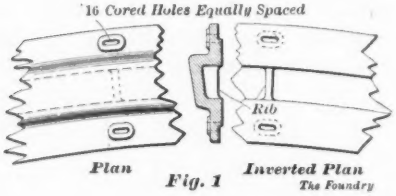


Fig. 1

One method of solving this problem is shown in this article.

In the case under discussion a number of large circular rings had to be made, a section of the rings being shown in Fig. 1, which illustrates a partial plan and cross section. Eighteen of these rings were required, and as they were some 12 feet in diameter it will readily be seen that six separate molds will occupy a very large floor space. The problem was solved by simply stacking or piling upon one another a series of cores which form the molds for the rings or pieces to be cast. Of course, it is necessary to provide a proper arrangement of gates so that the rings may be cast from the same runner, and also to provide risers. While this method of molding will not under ordinary circumstances be found the cheapest on account of the expense of making the cores, etc., it will be found that the extra expense incurred will not condemn the method, owing to the saving in floor space, etc.

Eighteen of the rings were required, each being 12 feet in diameter and weighing about 3,800 pounds so that six rings would take up all the metal from one heat.

A cross section of one of the bottom cores, together with the box in which they were formed is shown in Fig. 2, the core box being shown

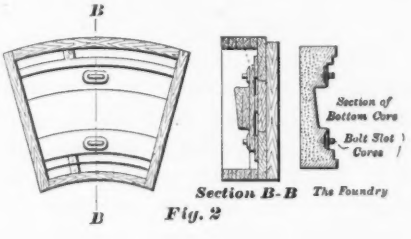


Fig. 2

in the plan and cross section. In like manner in Fig. 3 is shown a cross section of one of the top cores together with the plan and cross section of the core box in which it was formed. It will be observed that a male and female joint is formed upon the two cores this being necessary to locate them in position one upon the other.

Setting the Cores.

In constructing the mold a hole is dug in the floor to the required depth. The spindle with the sweep attached is next located in its proper position and a level bed struck off. The sweep is then raised to the required height and the lower half of the first series of cores placed in position. The proper diameter of the ring is maintained by setting the cores to the gauge A which is attached to the

sweep, as shown in Fig. 4. At the right of Fig. 4 is shown the setting of one of the bottom cores, while

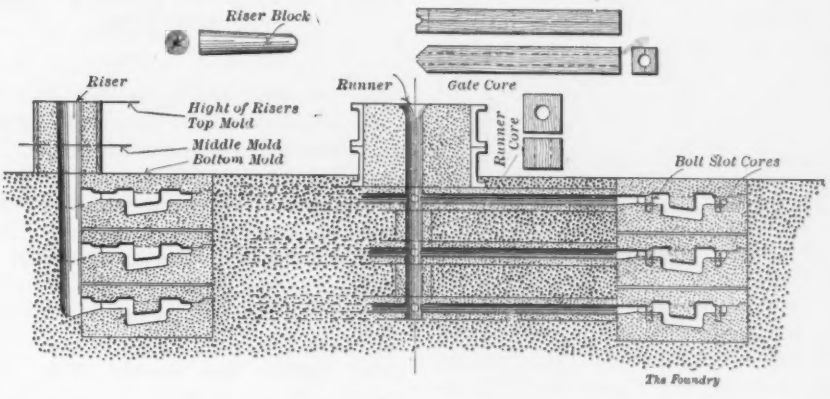


FIG. 5.

at the left of the spindle is illustrated the operation of sweeping off the bed to receive the cores. The upper series of cover cores is next placed in position, being guided by the male and female joints. A light thickness of sand is next applied over the upper surface, the sweep is raised up and the sand applied struck off level to receive the bottom cores of the second set. The second set of cores are located with the aid of the gauge A as in the first case. In this way the work is proceeded with until all three

The runner is centrally located and each ring receives metal from four gates placed at right angles to one another, as shown in Fig. 5, which

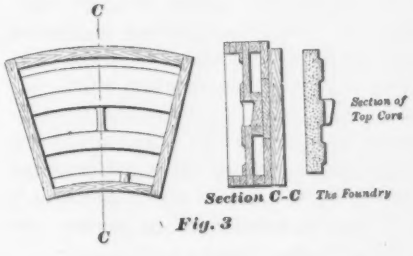


Fig. 3

illustrates two half sections of the mold. The section at the right being taken through the gates illustrating the manner of gating, while the sec-

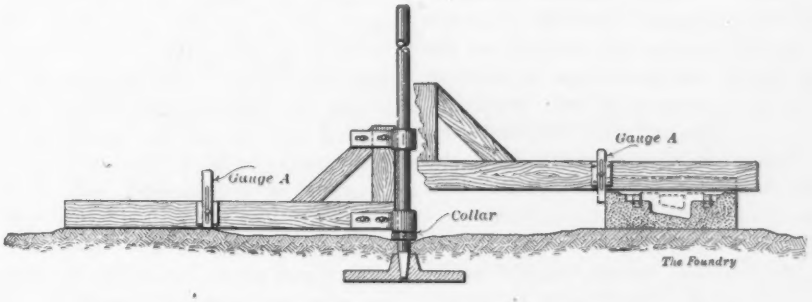


FIG. 4.

of the series of cores forming the complete mold have been placed in the proper position.

tion at the left is taken through the risers and illustrates the manner of attaching the same. It will be no-

ticed that the risers are placed on the outer diameter of the rings.

After the three series of cores are set in position the molder has to turn his attention to the placing of the runner and gate cores, the arranging of the risers. This work being done during the backing up of the mold with sand, as shown in the cross section of the completed mold. Sand is first rammed inside and outside of the cores to the height of the gate openings on the inner diameter of the cores and the risers' openings on the outer diameter of the first series of cores. The runner and gate cores are shown in detail in the upper part of Fig. 5 and also in position in the lower part of the figure. After the first set of cores for the gates are placed in position the first one of the block cores for the runner is placed in the center and the ramming in of the sand backing proceeded with until the openings in the second series of cores are reached when the gate cores and next block for the runner core are set as in the first case. When the backing of sand reaches the top of the upper series of cores a level bed is struck off to receive the holding down plates.

The risers are formed by the use of the riser block shown in the upper left hand corner of Fig. 5. The runner and risers are next carried up to the desired height and the weighting down of the cores attended to. It will be observed that the riser for the lower ring is not carried to the same height as the others on account of the fact that it is not necessary to do so. The riser for the first ring is terminated at the surface of the mold as indicated by the words "bottom mold." The riser for the second ring is terminated at the dotted line designated "middle mold," while the riser for the upper mold is carried up to the same height as the gate. When the metal in the first riser has almost reached the surface of the mold the riser is covered with a plate and weighted down. In like manner when the metal reaches the top of the second riser it is covered and weighted.

THE PATTERN MAKER AND THE MOLDER.

By E. F. Lake.

We see much feeling existing between the patternmaker and the molder. With the coremaker to help him out this should not exist and does not exist in the case of the most skilled mechanics of any trade, as the skilled workman in any line of business does understand that there is always something to learn from others, and consequently his mind is always open to receive new ideas which will benefit him. In shops I have worked in this feeling has bred a bitterness which should not exist in any well regulated plant. This feeling is largely due to the egotism with which all of us are blessed to a greater or less extent. Where this egotism is allowed to grow and run rampant in the brain it makes the individual conceited and his mind is not open to receive any new ideas which come from others. Such an individual is despised by all thinking men.

Having worked for a number of years at pattern making, a portion of which time was spent in some of the largest shops in the country, it has given the writer an opportunity to mingle with the members of the craft in many places, and to see this egotism displayed in many cases among them. It results in such remarks as "What does he know; he can't even read a blue print?" or, "Why, he can't work within a quarter of an inch any way." These remarks are among the patternmakers. When speaking of the molder or coremaker, we have seen him walk down through the gangway of the foundry with a strut trying to look wise, but with such a swelled head that it was impossible for him to pick up any new idea by observing what was going on around him. This is also true of the patternmaker in some cases when he visits the foundry.

The growth in the size of the manufacturing plants of the present day does not tend to remove or alter this feeling, as it is becoming more difficult each year

for the patternmaker to get into the foundry, and pattern apprentices are being taught the trade without even having seen the foundry. For all that a patternmaker knows of the molder from actual experience he might be some form of wild animal, unless by chance he should meet one outside of the shop and find that he was an acting thinking individual and his equal in every respect, except possibly the sawdust in his hair.

On the other hand we see the molder and the coremaker doing the same thing and hear them making such remarks as "Here comes the collar and necktie brigade," when two or three patternmakers may happen to get into the foundry to try to learn something of the way patterns are molded and cores made, or we may hear, "What does he know about making a pattern for a molder to use, he doesn't know a gagger from a bottom board," or when the patternmaker is sent to the foundry to set up a new core box that has just been made and which has so many loose pieces that it would keep a man busy for some time that had never seen it, we hear the coremakers say, "Here comes the wise guy." But with the growth of the manufacturing plant the opportunity to give voice to these feelings is being removed, as on account of the fact that the two classes do not come in contact with each other as often as they used to, there is not as much opportunity for such remarks.

The cases which I have cited above, however, I am happy to say are in many cases the exception and not the rule, for we see the thinking, acting men of both crafts willing to listen and learn from each other. These thinking and acting men are the most skilled mechanics, as it takes brains which can and which are used for observing and thinking to make mechanics. Those in every craft who do not use what brains they have for the purpose for which they were given are fast being relegated to the scrap pile or dump in this age of rapid progress.

As the pattern is of necessity constructed before it is molded it is up to the patternmaker to so design it that it can be molded in the easiest and best way, and this is invariably the cheapest way. It is, therefore, necessary for the patternmaker to have a knowledge of the foundry practice before he can call himself a first-class mechanic. The best way to gain this knowledge is from the molder who has had the practical experience and knows where a move can be saved here, a roll-over saved there, and a loose piece put on some where else which might aid him in slicking up the mold or save him patching it up where the sand might break away.

Information can also be obtained from the coremaker as to the best method of parting core boxes, whether a bottom board is needed or not, where loose pieces can be used to the best advantage, etc.

As the time consumed in building the pattern does not count for so much when a number of castings are to be made from one pattern, owing to the fact that every move saved for the molder and coremaker is multiplied from twenty-five to one hundred times or more according to the number of castings required, it is evident that in such cases the pattern cannot be constructed too well.

As the pattern must be molded by the molder the way it is designed and built by the patternmaker it sounds very much like egotism on the part of the superintendent of the foundry when we read the following, as the writer did last month in an automobile journal: "The preferred sequence of operations includes the making of the pattern to the customer's drawings under the direction of Mr. Blank (the foundry superintendent), who thus determines the method of molding, form of flasks, and position of the cylinder when poured, as well as the form of the core boxes, the joining of cores, instead of these highly important details being left to the discretion of the customer's patternmaker who is not at all likely to have Mr. Blank's knowledge of the best form of patterns and core boxes to produce the required cylinder, when these costly and intricate appliances are viewed from the molder's standpoint." These words were used in describing the molding of a gas engine cyl-

inder used on an automobile. The said cylinder was picked out of about ten or twelve different kinds which this foundry cast as the best designed set of pattern and core boxes for molders and core makers to use. The pattern and core boxes under discussion, however, were designed by the foreman of the pattern shop of the automobile company and as they did not have a foundry of their own, it was necessary to send them to a different city to be cast, therefore, the patternmakers could not get any information from the foundry, but designed the rigging from their own knowledge. It was completed and sent to the foundry last year in September, and about 200 castings were made from it before the first of January this year, which was the time Mr. Blank (the superintendent), took charge of the foundry, hence this piece was being cast successfully before he ever used it and no changes were made by the foundry either in the pattern or core boxes, but they are being used today just in the form they were designed by the foreman of the pattern shop of the automobile factory. This is only one case like many others we see at the present day where the man in charge gets his ideas from the practical workmen with which he comes in touch and then in order to boost himself claims them as an original product of his brain, thus climbing over the backs of others to reach his goal.

This pattern was designed to cast the top of the cylinder in the drag or nowell, as it is in that part of the cylinder that the compression chamber and inlet valves are located. Also the part of the piston chamber which has to stand the brunt of the explosions, and it, therefore, should be of the best iron in the mold. When this rigging was sent to the foundry the molder turned it other end up, making the most important part come in a cope so that if there were any gas bubbles from the cores, loose sand or facings in the mold, etc., they might lodge in the numerous pockets in the mold formed by the water jacket, compression chamber, or inlet and exhaust cores, thus causing bad spots in the iron at the point where it should be the best. The molder was informed, however, that it was desired that the cylinder be molded with the top in the drag and after the first two or three castings it was made that way.

Thus we see from the numerous experiences we go through that each trade is a trade by itself and even though they may be closely connected it is almost impossible for one individual to solve all of the intricate problems which arise almost every day in both trades for this reason when one tries to criticise the other, or claim to have the knowledge which the other possesses he generally puts his foot in it and exposes his ignorance.

While it is necessary for a patternmaker to have a knowledge of the way a pattern should be molded and the core made, he does not need to possess a knowledge of many other foundry details which the molder must know, such for instance as the proper tempering of the sand, how hard the sand should be rammed, the size of the flasks to use, the baring of the flask, the use of gaggers, chaplets, etc., and where to place them, the composition of the iron, steel or brass to be used in pouring, the mold and the temperature at which the mold should be poured, the amount of sand, flour, molasses, stale beer, etc., to use in making cores, also the placing of wires or rods in the core, the venting of both the cores and the molds and other smaller details. Therefore, the patternmaker who thinks he knows all about molding should spend a few weeks in the foundry, when he would find how limited his knowledge really was and might come out with a higher opinion of the intellectual capacity of the molder. On the other hand, if the molder could put in a few weeks in the pattern shop he might learn why the patternmaker designs the pattern to part a certain way in order to get the cores in, why the patterns are made of hard wood, soft wood, or metal, why fillets are put on in one place and left off in another, so that in the latter case the molder or coremaker has to cut them with his trowel, why the lifting or rapping plates put on by the patternmaker should be used by the

molder in place of a pointed iron rod even though the latter may be the first thing his hands reach, also why a sledge hammer should not be used to pound upon the wood of the pattern. There are many other things which he would probably pick up during his sojourn in the pattern shop.

An exchange of ideas and experiences as above mentioned would undoubtedly tend to stop the knocking which goes on in some shops between the two crafts and teach them that only by co-operation could they obtain the results which both desire.

TRADE PUBLICATIONS.

The Joseph Dixon Crucible Co., of Jersey City, N. J., is sending out a publication entitled "Through Frisco's Furnace." It is 8 x 10 inches, printed on very fine paper and contains half-tones showing a number of the prominent buildings in San Francisco and the manner in which they withstood the fire. The object of the work is to show how the silica-graphite paint, manufactured by the Dixon Co., served to preserve the steel framework of the buildings and protect them from injury both by fire and earthquake. The publication contains a large amount of material of interest to all who have construction problems to deal with.

The John G. Stein & Co., Ltd., manufacturers of silica and fire bricks, of Bonnybridge, Scotland, have issued a publication describing, first, the plant of the company, and second, the product, which includes a very large variety of fire bricks for different special purposes.

The Chicago Pneumatic Tool Co., of Chicago, Ill., has issued a four page circular descriptive of the Duntley air cooled electric drills, also portable grinders and chipping hammers.

The C. W. Hunt Co., of West New Brighton, Staten Island, N. Y., has issued a small booklet 3½ inches x 6 inches, descriptive of the Hunt industrial railway system, pointing out its various advantages. One of the most interesting features of the work is to be found in a large number of photographs of special cars made for many different purposes. Pages 23 to 43 of the booklet are devoted to photographs of these special cars and a careful examination of them should prove of great value to anyone who has transportation problems to deal with in manufacturing plants.

The Bruce-Meriam-Abbott Co., of Cleveland, O., has issued a standard size (6 x 9 inches) booklet of 32 pages describing the gas engines manufactured by this company. One of the engines made by this company was used in the exhibit of foundry supplies recently held in Cleveland in connection with the American Foundrymen's Association, and gas engines are coming into very much more general use as a source of power to the foundries each year.

The Bristol Co., of Waterbury, Conn., has issued a small booklet, 3¼ x 6 inches, Bulletin 41, which describes the various types of recording instruments manufactured by this company.

GENERAL INDUSTRIAL NOTES.

At the annual meeting of the stockholders of the American Skein & Foundry Co., Racine, Wis., the following officers were elected: President, Walter F. Walker, Racine; vice president, Jos. F. Davidson, Columbus, O.; secretary and treasurer, W. B. Mitchell, Racine.

A new company has been formed for the erection of a malleable iron foundry in Marshall, Mich. S. C. French has been instrumental in forming the company and S. F. Dobbins is president. A foundry, one story, and 60 x 120 feet will be erected, and about fifteen men will be employed at first. The capital stock is $10,000.

P. C. Webb has returned to Hutchinson, Minn., and will reopen his foundry and machine shop, which has been closed for some time.

The Pass City Foundry & Machine Co., El Paso, Tex., has resumed operations after an idleness of several weeks.

Walter T. Dette has secured a completely equipped foundry, with machine shop and power house, at Garwood, N. J., which he will operate under the name of the Enterprise Foundry Co.

SEMI-STEEL CASTINGS.

By Harry Malone.

Semi-steel is one of those misnomers which has crept into the foundry business, and really does not mean anything. It has occurred to me, along this line, that a very interesting article could be written on "what foundry terms do not mean," but as Kipling says "That's another story," and so this time the writer will try and confine his attention to what semi-steel does, or does not, mean. The wordologist, or whatever else you call the man who dissects words, hunts up their roots and determines their meaning thereby, would probably tell you that semi-steel means half steel or pretty nearly steel, and working along this analogy he would probably expect that it was made by some steel making process.

The reason that some iron is gray and has a coarse crystalline fracture, which renders it relatively weak is that there is present a considerable quantity of carbon, which, with the amount of silicon present, forces it into the graphitic or free state. Now castings from this iron can be made dense or stronger by reducing the silicon which tends to throw the carbon into the combined state or by reducing the carbon which will tend to smaller carbon crystals, or both, reducing both carbon and silicon.

This reduction may be accomplished in one of two ways. First, some of the carbon and silicon may be burned out, and second, material may be added which is low in carbon and silicon and will dilute these elements.

In cupola furnace practice it is impossible to control the elements by burning out or oxidizing any of them, and hence the only alternative is to dilute them by adding steel scrap. The product thus derived was given the name of semi-steel by somebody who thought it would be a high sounding name under which to sell a good grade of close grained casting produced by this process, and the name thus given has stuck.

To produce the so-called semi-steel from steel or wrought iron, steel or wrought iron scrap is charged in the cupola with cast iron scrap and pig iron. Steel scrap is better for this purpose than wrought iron on account of the fact that its melting temperature is much nearer that of the cupola. The only way wrought iron is ever melted in a cupola is by its becoming hot and the surface absorbing carbon from the coke. This absorption of carbon reduces the melting point and the surface melts off. The carbon penetrates the next layer, which in turn melts off, and the process is thus continued until the entire mass is melted. If any wrought iron sinks to the lower portion of the melting zone some of it is also probably melted by the drops of melted high carbon iron falling upon the wrought iron and blending with it, the carbon from the molten iron passing into the wrought iron and resulting in two or more drops of iron containing a percentage of carbon between that of the pig iron and the wrought iron. The lower the percentage of carbon the more difficult it is to melt the iron in the cupola, and the greater the liability of irregular work.

If the wrought iron sinks to the lower edge of the melting zone, it is simply burnt up and passes into the slag. The effect of a charge of wrought iron or low carbon steel will usually be felt through several succeeding charges, owing to the fact that the cast iron is melted long before the steel, and two or three charges may come down before all the wrought iron or steel has been melted. As a rule the best stock for melting purposes is found in plate shearings or punchings or in the ends cut from shafting. Very thin sheet scrap should always be avoided as should also fine punchings and borings, as this class of material will work to the lower edge of the melting zone and be almost wholly burnt up or oxidized.

Where an air furnace is available the same results can be obtained and, in fact semi-steel made in a cupola is usually passed off as a substitute for air furnace iron. There is no profound secret about the so-called semi-steel. In a word, it is nothing in the world but a cast iron in which the percentage of carbon and silicon have been cut down by the introduction of low carbon stock.

FLUOR SPAR AS A FLUX.

The following letters have a bearing on the flux problem and will be of interest to foundrymen:

N. W. Shed, Esq., Dear Sir.—We have read with considerable interest your article in the July edition of THE FOUNDRY on fluxes in the cupola, and we notice you take a very strong line against the use of fluorspar as a flux, and it is to this we wish to take exception.

We have had considerable experience amongst English iron founders, and are now supplying fluorspar regularly to a very large number of them, and have a great many unsolicited letters stating the exceedingly advantageous results that they have obtained from the use of fluorspar.

In the first place you state in your article that from a practical test made by you, you found fluorspar to be an inferior flux.

Second, that it does not remove sulphur.

Third, that the properties of the iron were not improved in the least by its use.

Fourth, limestone is far cheaper than fluorspar, and a far better flux.

Now to deal with this, in the first place fluorspar as a flux, not only in cupola practice, but generally, is much more valuable than limestone. It has the power of liquifying the silicious and gangue minerals to a remarkable extent, to a very much greater extent than limestone, and on that account its use in metallurgy is very rapidly increasing. The production of our mines is now over 50,000 tons per annum, and is steadily increasing.

In the second place, a large number of the founders in this country admit that they do find a reduction of sulphur contents in the iron when fluorspar is used. Its action on sulphur is also borne out by the fact of its extensive use in the basic open hearth furnace for the elimination of sulphur in the basic steel process.

As to the improvement or otherwise of iron when fluorspar is used in the cupola, we have evidence of a large number of the best founders in this country that they do find the iron improved. Fluorspar undoubtedly assists in eliminating slag, the slag is thinned, and the metal is kept hotter, consequently sharper castings will be the result. In addition to this the charge in the cupola is brought down more rapidly by the use of fluorspar.

As to your last contention that limestone is far cheaper than fluorspar, this of course goes without saying, but you do not make it clear in your article that the intention is not to use fluorspar alone as a flux, or as a substitute for limestone, but that the fluorspar should be used in conjunction with the limestone, the usual mixture being about 20 lbs. per ton of iron melted.

It will be obvious, therefore, as the percentage of fluorspar used is so small, the additional cost of using it is exceedingly trifling, and is far more than outweighed by the many advantages obtained by using the spar, and also probably by the saving in fuel due to the iron coming down more rapidly.

In conclusion we cannot do better than refer you to the very able papers and articles that have been read and written by Mr. A. E. Outerbridge, who has pretty conclusively proved the many advantages to be derived by using fluorspar in the cupola.

We have sent copy of this letter to the Editor of THE FOUNDRY asking him to be kind enough to insert it in the next issue.

As we are the largest miners of fluorspar in the world, we are naturally interested in anything that refers to the consumption of this article, and consequently we think it necessary to ask the editor of THE FOUNDRY to publish this letter, as firms who have not hitherto used fluorspar might be deterred from doing so by reason of your remarks. We shall be pleased to hear further from you and to correspond on the subject.

GEORGE G. BLACKWELL, SONS & CO.

George G. Blackwell, Esq., Dear Sir:—I have been much interested in your letter regarding fluorspar as a cupola

flux. You mention its great value in the open-hearth basic process, and there you are undoubtedly right; you could mention several departments of metallurgy where fluorspar is much used with good results, but my contention is that in cupola practice there is no value in fluorspar.

Fluorspar is used largely by founders who do not known how to use limestone. A great many foundrymen do not flux the first four or five charges in the cupola at all, and then the cinder becomes very thick and infusible, and tends to block up the furnace. Limestone added in quantity at this point does little good, and fluorspar will sometimes thin the cinder so that the furnace is loosened up. This is a drastic remedy and the amount of fluorspar used is often enough to flux the fire brick as well as the bridged-over cupola. If a suitable amount of limestone had been used on the first four or five charges and especially a good dose on the first coke charge, there would be no trouble; the slag would be perfectly liquid and the cupola would run all day and night if necessary.

The fluorspar people in America assert that their flux, when used in small quantities, removes sulphur, but I fail to find a record of any such performance. Theoretically, fluorspar and also limestone, should remove sulphur, but practically such a very large amount would have to be used that you would use up a large amount of coke in melting the very limey slag produced. The 20 pounds of fluorspar used on a 6,000 pound charge of iron, would remove but an infinitesimal amount. In fact, 200 pounds of limestone removes very little sulphur.

It is hard to see how the quantity of the iron can be improved by fluxes of any sort. The strength of iron is usually dependent on the amount of silicon in the iron, and there is no way that the fluorspar cinder can reach the silicon held by the iron.

You speak of the slag being thinned and the metal being hotter. Thinning the slag will never heat the metal. You have to burn coke to get the metal hot, and some of the hottest metal can be made with a thick cinder.

In this town there is a great deal of very hot metal poured in sharp castings, and not a pound of flux of any kind is used.

I have met Mr. Outerbridge in Philadelphia, but I have never heard him say anything about the value of fluorspar, and I have read a great many of his papers without seeing anything regarding the use of fluorspar.

My observations were made from watching the results of fluorspar and of limestone on the three (3) cupolas of the Buffalo Foundry Co. The large cupola 84″ in diameter has been melting over 100 tons a day for two years, using limestone and making a perfectly fluid cinder all the time. What, therefore, is the possible gain in using fluorspar in this case?

The large company, of which you are the head, would do well to make a scientific test of the value of fluorspar. Let the cupola be run by an unprejudiced metallurgist. Let the iron be analyzed before melting and after melting; let the cinder be analyzed too. Have the tensile strength of the iron measured; compare the loss on brick work, etc. Run four heats with fluorspar and four heats with limestone, then we would know just the value of fluorspar and the record would be of value to the foundry world.

Yours respectfully,

N. W. SHED.

GENERAL INDUSTRIAL NOTES.

The Twentieth Century Brass & Iron Works, Minneapolis, Minn., has just bought out the Acme Brass Works and has incorporated for $50,000. The company has rented 7,000 feet of floor space for a plating plant and foundry, and is installing machinery for the manufacture of plumbers' supplies, radiator valves, and all kinds of brass work. When completed, the plant will be the largest of the kind west of Chicago.

The Cadillac Motor Car Co. is to begin the operation of a brass foundry at its Leland & Faulconer plant, Detroit, Mich. Four furnaces are to

be installed for this purpose.

The Peerless Heater & Valve Co. has filed amended articles of incorporation, increasing its capital from $50,000 to $75,000. This company recently removed from Detroit to Saginaw, Mich., and is operating the plant formerly occupied by the Auto Brass & Aluminum Co.

The largest steel casting ever made in the United States has been turned out at the Falk Mfg. Co.'s plant, Milwaukee, Wis. It is for a turbine for the Allis-Chalmers Co. The single casting weighs 45 tons. This work has attracted the attention of foundry experts all over the country, one being Stranton Griffith, of the Fairbanks Co., of Beloit, the inventor of numerous foundry machines. It has been a great undertaking and has been successfully accomplished.

The Rex Mfg. Co., Jersey City, N. J., has been incorporated to operate foundries and machine shops and conduct an engineering and contracting business, with a capital of $100,000. The incorporators are W. F. Midlidge and M. C. Jenkins, of Jersey City, and W. A. Harland, of New York City.

The business of John H. Lindsley, 244 Main street, Orange, N. J., has been incorporated for the manufacture of heavy and shelf hardware, mill supplies, and to operate foundries and machine shops. Capital stock, $100,000. Incorporators, John N. Lindsley, Mary S. Lindsley, Isabel Lindsley, Cleveland street; William F. Rockwell, Essex avenue, all of Orange, N. J.

The Star Foundry Co., Covington, Ky., has lately been reorganized. The incorporators of the company are George Klaene, Anton Graving, Gerhard Haas and August Oberding. The capital stock is $20,000.

The Stern Foundry & Machinery Co., New Orleans, La., recently incorporated with $100,000 capital, will take over the Boland-Gschwind manufacturing plant, make extensive improvements, and put it in operation at once. Nathan S. Stern, for the past 18 years connected with the Schwartz Foundry Co., is president and general manager.

The Carter Iron Co., Paden City, W. Va., has been organized with a capitalization of $300,000 to take over the plant of the Ohio Valley Foundry & Iron Co. George T. Lewis is promoting the interests of the new company.

The McCune Iron Co., Birmingham, Ala., has been incorporated with a capital of $75,000. J. H. McCune is president and general manager. The new concern has acquired the plant of the Birmingham Engineering & Construction Co., at North Birmingham, and will improve this plant and resume operation at the earliest possible moment, doing a general foundry business.

The Watervliet Foundry & Machine Co., Watervliet, N.Y., has been incorporated with a capital stock of $60,000 to operate a foundry and machine shop. The incorporators are Harry R. Kelly and George B. Kelly, Troy, N. Y.; Michael Foley and John V. Hemstreet, Herkimer, N. Y. The contract has been let for a foundry, 75 x 150 feet, in which heavy machine castings will be made.

The Sweet & Doyle Valve Co., Troy, N. Y., will equip a complete iron foundry in the near future, and will require considerable machinery.

The Seaboard Pipe Foundry Co., recently incorporated at Savannah, Ga., has purchased the plant of the Atlantic Mfg. Co., and will increase its capacity to 20 tons of soil pipe per day. The capital stock is $200,000, and E. F. Hartfelder and George A. Garbutt, both of the Hartfelder-Garbutt Co., are interested.

The Globe Foundry Co., which already has its plant at Huntington, W. Va., well under way, has been organized with a capital of $250,000 by John F. Mills, William A. Mills, Frank M. Mills, H. L. Marshall and H. L. Marshall Jr., all of Port Chester, N. Y.

The Advance Brass & Valve Co., Detroit, Mich., has been organized with a capital stock of $25,000, most of which has already been subscribed.

CONVERTER STEEL CASTINGS PRACTICE. NUMBER 1.

By Arthur Simonson.

It will be the author's object in this and succeeding articles to give a general idea of the science and art of making steel castings in a foundry equipped with the Tropenas system of steel making. Some of the ground has been more or less fully covered in previous articles by the writer, but it is now proposed to treat consecutively of the scope of the process, of the equipment necessary and the methods of procedure. The present

Fig. 1.

article will discuss briefly the range of usefulness of the process, and describe the mechanical plant in more or less detail.

It is a mistake to think that the company operating a small converter plant can successfully compete in all lines of the castings business. There are undoubtedly branches where it is beaten by the open-hearth and the malleable iron foundry. The writer is not exploiting the Tropenas process and has no bias in favor of it beyond what a twelve years' operation of it has given, and he is entirely cognizant of its limitations. There are few things so light that they cannot be cast from the excessively hot steel made in the small converter, but for these tiny pieces, gray iron, malleable iron or brass are generally strong enough. On the other hand, for the very large pieces, say over eight tons in weight, the open-hearth is probably cheaper, in America at any rate, though in England a plant operating five converters is successful in competition with the open-hearth and turning out over six hundred tons per month of miscellaneous castings of all analyses, and varying from less than a pound up to ten tons.

The field of the small converter is ideally in the small and medium castings, and those calling for a specially high-grade material. It is an undisputed fact that a well handled converter of the Tropenas type produces a superior quality of steel, sounder, closer grained and stronger. In automobile work, motor boats, in the construction of coal and ice wagons, for gears, valves and levers, turbine work, gas engines and general machine work, the small converter is particularly *au fait*.

The realization of what can be done in the way of making light and intricate castings has led to the elaboration of engine and machine details in a remarkable way. A designer has no longer to take into consideration the possibility of not being able to get the castings he requires in steel. The small converter has made it possible to develop tremendous power in engines occupying small space, and as proposition after proposition is put before the founder and solved, he is beginning now to realize the possibilities of the process. The increasing number of plants being erected and the success with which they are meeting testifies to the realization of the claims made for it since its inception.

It is worthy of notice that the open-hearth people are now beginning to realize the usefulness of a small converter as an annex to their large furnace, in this way being able to take care of absolutely any business that comes along, and relieve the big furnace of the tedious costly necessity of making the small castings. There is today also at least one case of a malleable iron foundry install-

ing a Tropenas converter. It seems probable that the time is near at hand when every open-hearth furnace operating on castings will have as an adjunct one or more converters, the idea would then be to make all the small castings with the converter and just enough of the larger ones to fill in up to capacity. In dull times the entire output might be economically made with the converter.

We will now describe in detail a plant consisting of one two-ton converter and having a capacity of about forty tons of castings per week. It consists of con-

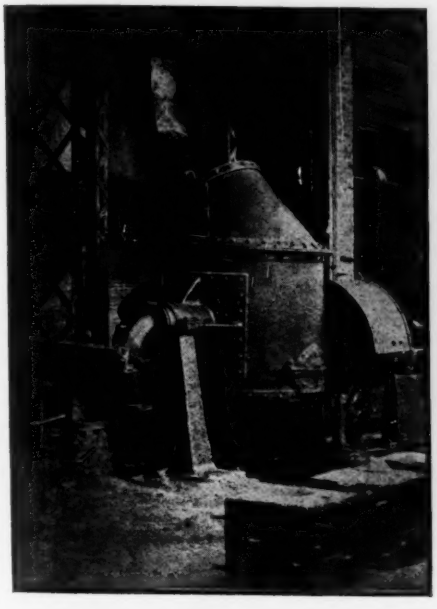


FIG. 2.

verter, converter blower and motor, "pulpit," of operating station, cupola, cupola platform and elevator, cupola blower and motor, ladles and ladle heating plant, sand grinder and mixer.

An analytical laboratory is also indispensable, and this has been made the subject of a special article. As for the foundry equipment, that is, cranes, flasks and miscellaneous rigging, they are the same for all foundries, no matter what process is used, but it may be well to make a few general remarks on this subject in passing.

Electric traveling cranes are now almost exclusively used with wall or jib cranes as accessories. All foundry buildings are of steel construction with ample lighting facilities. Up-to-date plants are provided with heating and ventilating systems so that in summer air from outside can be distributed through the building, and in winter it is passed through steam coils. The heating of foundries is a very important matter as if the sand is allowed to freeze it will cause endless trouble, particularly if green sand castings are made. The artificial lighting of a foundry for night work is a problem requiring considerable

FIG. 3.

attention. The atmosphere in a foundry is often smoky and always very dusty, and it requires a very good distribution of powerful lights to enable the men to work when necessary, as well at night as in the daytime. The ovens for drying molds should be as large as possible, and their trucks designed of such a type that the heating of axles and bearings will not affect their running qualities. Flasks, chains and general tackle should be as heavy as is convenient to handle. The less risk taken the better, and the foundry business has enough of them under the best circumstances.

The writer holds the opinion that any amount of money judiciously expended on special tackle and rigging in the

foundry pays a good dividend in safety, speed and economy.

Converter.—The converter is of two tons capacity, that is to say, it is capable of turning out at each operation approximately two tons of steel. In this article it will be considered as a machine only; its metallurgical side will be dealt with in the next paper. The illustrations Figs. 1, 2, 3, and 4 will give a good idea of the general appearance of the converter. Fig. 1 shows the side that is equipped with means for tilting, Fig. 2 shows the blast pipe connected to the hollow trunnion, Fig. 3 shows the converter in the pouring position with a bull

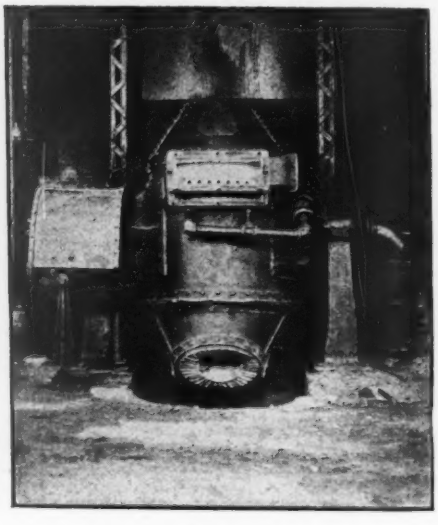
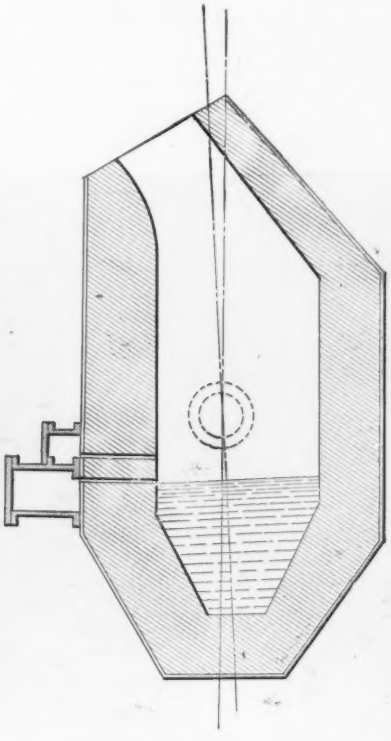


FIG. 4.

ladle in position to receive the metal, and Fig. 4 shows the converter dumped to empty the slag after the metal has all been poured out.

The shell of the converter is five feet in diameter and is made of five-eighths thick steel plates, perforated with three-quarter inch holes spaced eight inches center to center to allow the steam to escape when drying the lining. The amount of floor space occupied by the converter is about sixteen feet square and the head room required is about eighteen to twenty feet to enable the whole of the flame which comes out of the mouth, and which constitutes the means for judging the condition of the steel, to be seen at all times.

The converter is supported on steel trunnions, one of which is hollow and forms a duct for the air, connecting with the blast box at the back of the converter. This enables the air to be kept on continuously while the position of the converter is being changed. The blast box is a double one, and air can be admitted to either one separately, or in varying proportions. This is partly seen in Fig. 5, which is a section of the converter both horizontal and vertical, showing the arrangement of the tuyeres, the level of



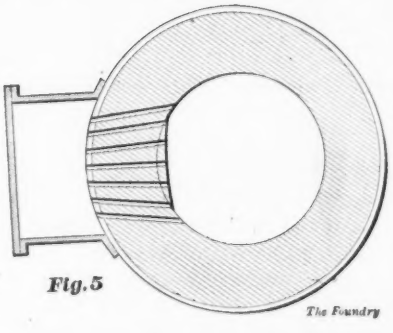


Fig. 5

The Foundry

the bath and the approximate position of the vessel while the blow is being made. The other trunnion is extended and carries a worm wheel which through suitable gearing is connected to a four-horsepower motor. A hand wheel is also provided for making small movements of the vessel as required from time to time. The electric motor is the common means adopted for tilting the converter, although any means may be employed, and plants are in operation in various places running with compressed air, steam and hydraulic power. This is a mere detail and depends on circumstances. The converter is firmly bolted to pedestals,

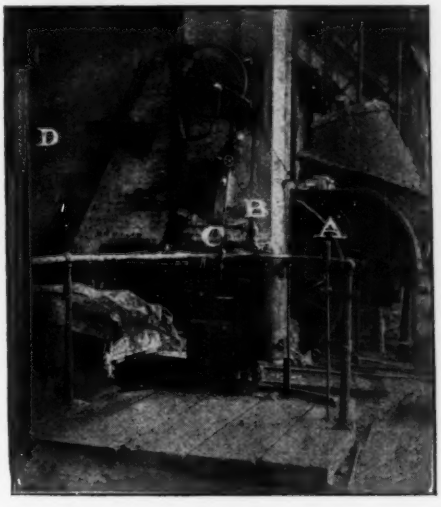


FIG. 6.

which are sufficiently high to allow the converter to make a complete revolution if necessary. This is advisable for facility in emptying the converter, and also to enable the whole of the metal to be poured out before the vessel is too low for the men to hold the ladles.

The covers of the blast boxes are fastened on by means of keys, for quick removal, to clean out a tuyere or to set the converter at the commencement of a blow. The upper box is fitted with a pipe having an independent valve so that it may be shut off entirely if desired, or any required amount of blast admitted according to the conditions that arise as the blow proceeds. The lining of the converter will be dealt with in the next number.

Converter blower and motor.—The blower is of the positive pressure type, and must be capable of maintaining a constant pressure up to four pounds per square inch through the area of both sets of tuyeres, which consist of seven in the lower row, one and three-eighths inches in diameter, and seven in the upper row about one and a half by five-eighths inches. The number three and a half Root blower, water jacketed, running at about four hundred revolutions per minute, is commonly used and is satisfactory. Blast may be supplied by blowing engine, but is not so satisfactory as the pulsations of the engine, unless absorbed by a very large receiver, are manifest in the flame and interfere with the observation of the reactions. A rotary blower is best on this account as it gives a practically constant stream of air, and makes the flame perfectly steady at least as far as outside influences are concerned. The blower should be direct connected to a motor of about seventy-five horsepower; no less is advisable, as it is better to have a little power in reserve and not run the risk of the circuit breaker flying out all the time, for when this happens it always seems to happen at a critical time in the blow and may lead to clogging of the tuyeres, loss of time and possibly disaster to the blow. The blower should be placed near to the converter, but not too near as a fair length of the twelve-inch air main serves as a reservoir and gives elasticity to the blast, but elbows in the pipe should always be avoided.

Operating or controlling station.—This is the place where the operator stands to watch the progress of the blow, to tilt the converters according to the different requirements of charging, pouring, etc. It is better to place this at one side of the vessel, about twenty feet away if possible, so that the heat will not inconvenience the operator and so that he may see the whole of the flame. It is not advisable to place the "pulpit" across the building as in this case the flame is foreshortened, and it is not possible to see the smoke, sparks, etc., so clearly.

The "pulpit" contains the controller for tilting motor, the lever of the by-pass valve to regulate the pressure of air going into the converter, a signal whistle to the blower room to signal to the engineer when to start and stop the blower, and a mercury pressure gauge. The engineer on receiving the signal of two short blasts, starts the blower at full speed and maintains it at this speed all through the blow. Variations of pressure are then obtained by the operator opening or closing the by-pass and allowing more or less air to escape through a pipe leading to the outside. The blast gauge, reading in pounds, is attached to the blast main between the blower and the by-pass. Fig. 6 gives a view of the "pulpit", and A is the lever of the by-pass valve, B is the controller of the tilting motor, C is the whistle and D is the mercury gauge.

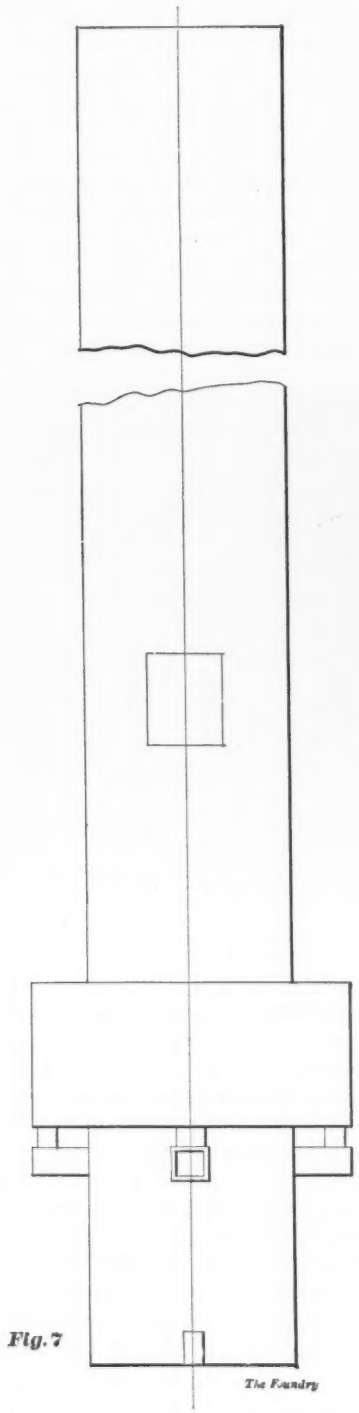


Fig. 7

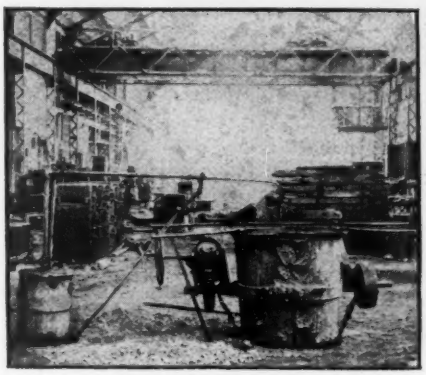


FIG. 8.

Cupola.—There has been a great deal of discussion as to the best type of cupola for the Tropenas converter. It is largely a matter of opinion. The fact is that it is needed to melt about five tons per hour of a charge consisting oftentimes of as much as fifty per cent of steel scrap, to melt it hot, and to be capable of running very long heats, sometimes as long as eight or nine hours. Any cupola that will meet these conditions is suitable. It must be remembered that in melting low phosphorus stock such as is used in steel making, a hot melting cupola is necessary, and facilities must be provided for taking care of a large quantity of slag, as considerable flux is used to keep the sulphur as low as possible. Discussion has taken place as to

the desirability of having a cupola large enough to melt the total charge for one blow at one tap, or getting it at two taps. After long experience the writer has come to the conclusion that a somewhat special cupola is the best, and this after using almost every kind that could be mentioned. The writer's idea of a suitable cupola is one built on the lines of a blast furnace, with a bustle pipe and pendant tuyeres such as is illustrated in Fig. 7. The bustle pipe or blast box

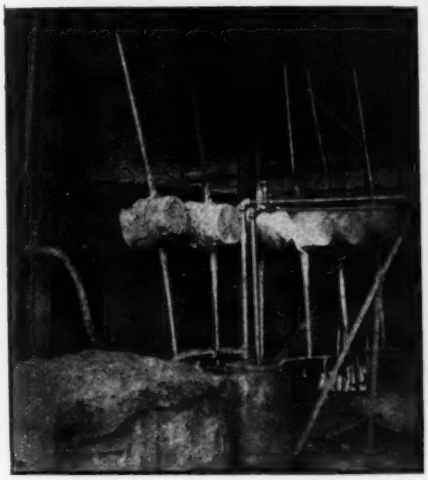


FIG. 9.

must be ample in size in order to maintain equal pressure at all of the six tuyeres. The advantage of this type of cupola is that the tuyeres are always clean, and if any slag or iron runs into them it runs out again without going into the blast box.

The cupola should be about fifty-four inches in diameter, lined with two rows of four and a half bricks, giving an inside diameter of thirty-six inches. The tuyeres should then be placed so that the slag hole which is six inches lower than this, will be sufficiently high to allow of the required amount of iron being tapped out when it has melted up to this height. In this way the cupola will be kept entirely free from slag, the tapping spout will be kept clear through a long heat, and there will be little risk of scaffolding. A blast pressure of from ten to fourteen inches of water should be maintained.

Cupola platform and elevator.—The cupola platform should be higher than is usual in iron foundries, as it should be arranged to take care of a height of not less than thirteen feet of cupola from bottom plate to charging door. The platform should be strong enough to carry a day's run of melting stock, and should be figured to carry not less than five hundred pounds per square foot. It should be roomy, and provided with facilities for good ventilation as a good deal of smoke from the converter finds its way up there and at times it is a very undesirable place to work. The elevator, preferably electric, should have a large platform and be capable of lifting about three tons at a time at a speed of about sixty feet per minute.

Cupola blower and motor.—Any of

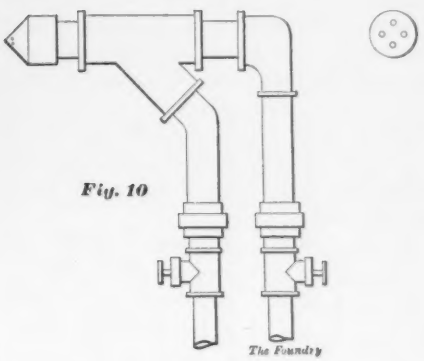


Fig. 10

the accepted types of cupola blower are satisfactory whether fan or pressure blower, but they should be designed to give ample volume, on account of the high tuyeres and the large percentage of steel scrap used in the charges. The motor is of about twenty-five horsepower.

Ladles.—The Tropenas converter makes such exceedingly hot steel that it can all be poured over the lip of the ladle, bottom pouring ladles not being necessary. For pouring small work such as is made in snap molds, hand or bull ladles holding about one hundred and fifty pounds are commonly used. They are about thirteen inches in diameter at the top and are lined to a thickness of an inch and a half. The shanks are

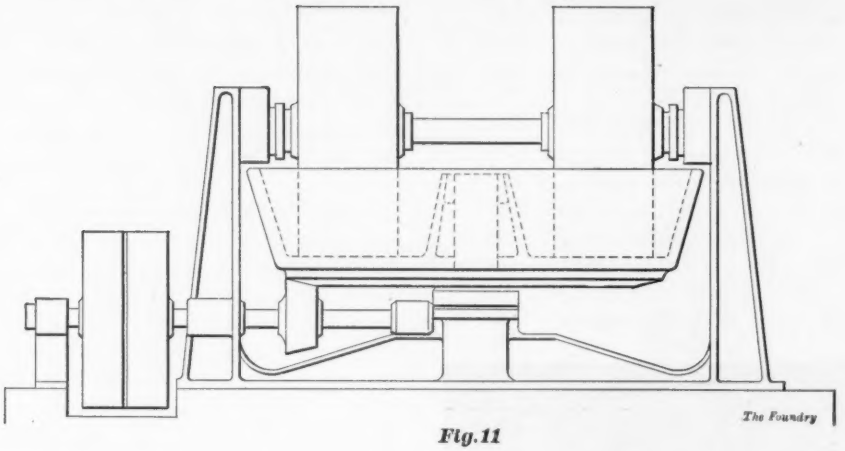


Fig. 11

about seven feet long, and have one double end for the man who is to do the pouring and a single end for the helper. The crane ladles are the same as iron foundry ladles, except that they are generally a little smaller in diameter in proportion to their height, to lessen the loss of heat by radiation. They are preferably geared with pin spur gearing instead of worm and wheel as this gives a greater control, steadier flow and less possibility of a drop of the ladle when the gearing is worn.

Ladle heating furnace.—Ladles are generally heated to redness before filling with steel. In the case of the large ladles this is done either by inverting them over an oil-burning furnace, or introducing an oil burner through a portable cover placed over the top of the ladle. The latter is illustrated in Fig. 8.

A device for heating small ladles arranged by the writer is shown in Fig. 9. It consists of a series of small oil burners placed side by side, spaced about eighteen inches apart from center to center, and a vertical plate with a two-inch hole opposite each burner, through which the flame passes and fills the bull ladle which is reared against the plate. In this way any number of ladles can be heated, according to the length of the plate, or, if required, one ladle can be heated white hot in ten minutes. It takes up very little floor space, is clean and easy to operate. Fig. 10 is a detail of the burner.

Sand grinder and mixer.—A grinder of the roller type is generally used. Centrifugal mixers have been tried, but they are not so successful, as they do not seem to thoroughly incorporate the clay

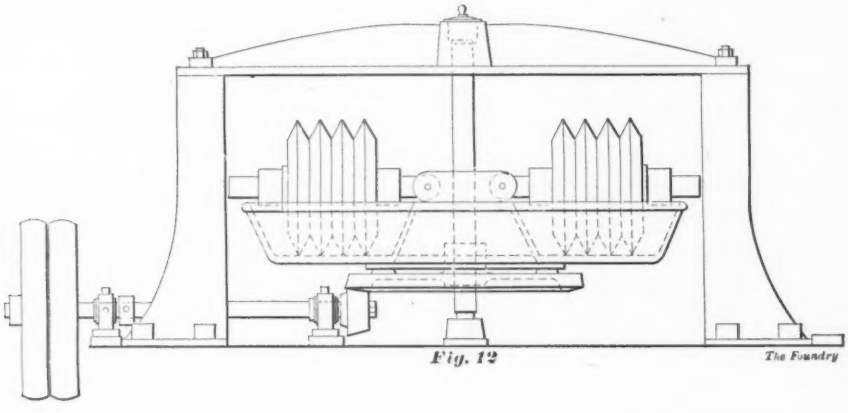


Fig. 12

with the rest of the ingredients. The usual type of mixer is illustrated in Fig. 11, but the writer prefers such a one as is shown in Fig. 12. In this type, while we get perfect mixing, we do not get so much crushing of the grains, and the resulting sand is more open, as is desirable in steel molding. This mixer is also very speedy in mixing sand, making it "strong" in much less time than the heavy roller grinder. The preparation of molding sand will be described in a later article.

The foregoing remarks constitute a general description of the mechanical part of a Tropenas plant. The next article will describe its operation.

SOME NOTES ON THE CHEMISTRY OF CAST IRON.*

By L. Houghton, Chesterfield.

Having been asked only at the last moment, almost, to read a paper at this meeting, the writer has not had time to prepare and present very much original matter. As this, however, is a meeting of practical men, some notes on the various constituents of cast iron which represent the experience gained as a chemist in dealing with cast iron, may not be out of place.

What follows is not intended to be an exhaustive exposition on the constitution of cast iron, but rather a resume of some points which have interested the writer from time to time.

The subject is divided for convenience under the heads of the chief constituents of cast iron.

Carbon. — This substance, whose presence in combination and alloy with iron is almost alone responsible for the range of metals mild steel to cast iron, has naturally been the object of considerable attention at the hands of metallurgists. Much patient and careful work has been done in recent years in elucidating the problem of the mode of occurrence of carbon in steel and indeed in this respect our knowledge of steel may now be regarded as fairly complete.

To cast iron, however, on account of the complications arising from the presence of large quantities of other elements, no very considerable attention had been given until quite recently.

Now that our knowledge of steel has been brought to a state of comparative reliability, there seems no reason why the more difficult problems in connection with cast iron should not be proceeded with apace.

For example: The diagram designed by Rooseboom indicating the changes occurring in the condition of carbon during cooling from the molten state, requires amending in the case of gray castings to show the effect of the various elements in changing the position of the critical points.

There is a certain amount of information on these points disseminated amongst current literature, but some graphical representation of it would be a very welcome adjunct to our means of studyir g cast iron.

The unreliability of the color test for combined carbon in cast iron is well known, as often the whole of the combined carbon is not indicated by the test. This is particularly the case with iron which has received heat treatment and is more obvious as the content of combined carbon increases towards white iron. Gray iron castings, normally cooled, are however, practically free from the feature, in the writer's experience.

An analysis of cast iron may indeed soon be considered incomplete when the carbon is stated in terms of graphitic and combined carbon only, and some indication will be necessary, either analytically or micrographically to show not only in what form the combined carbon is present but also to distinguish between the free carbon as graphite and as temper or annealing carbon.

The size of the grains of the graphite in cast iron has had a new importance given to it through the investigations of Professor Turner on this subject. According to Professor Turner's results, annealing carbon is

*Paper read before the British Foundrymens' Association at the Middlefield Meeting.

that which is sufficiently small to pass the 90 sieve. This finely divided graphite is more desirable in a casting than the large flakes, as the latter develop lines of weakness in the iron.

I had the privilege of making the analysis in connection with the paper on cast iron read by Mr. H. Pilkington, M. Inst. C. E., now your president, at your last meeting.

In this work I soon found that not only was combined carbon present in more than one form, but that the graphite was present after heat treatment in a very fine condition, and much of the benefit derived from the method of heat treatment there described is, in my opinion, due to this finely divided state of the graphite.

Processes for the production of this finely graphitic structure, whether of heat treatment or otherwise, will probably play an important part in the future history of cast iron.

In judging a pig iron for foundry purposes, however, the maxim is still true that the greater the ratio of the total amount of graphite to the total amount of combined carbon, the more valuable the iron.

Silicon. — From a purely chemical point of view, silicon is so closely allied to carbon that it would not be surprising to find a close relationship between them in the manner of their occurrence in cast iron. Indeed graphitic silicon has long been sought for, and may ultimately be proved to exist, whilst in combined condition silicon also very closely resembles carbon.

The subject is a somewhat difficult one and very little authoritative work has been done or at least announced, so far as the writer knows, although it may be that some at least of our troubles may find explanation on these lines.

TABLE I.

	I. Per cent.	II. Per cent.	III. Per cent.	IV. Per cent.
Total Carbon	3.75	3.62	3.53	3.62
Graphitic Carbon	2.85	2.90	2.95	3.37
Combined Carbon	0.90	0.72	0.58	0.25
Silicon Carbon	1.82	1.87	2.94	4.01
Sulphur Carbon	0.007	0.008	0.007	0.022

TABLE II.

Silicon added.	Size of Ladle.	Transverse strength.	Deflection.	Per Cent Alteration in strength.	Per Cent Alteration in Deflec.
¼ lb.	Hand ladle	2265 lbs.	.120		
none		2150	.112		
	Gain	110	.008	5.10	7.14
¼ lb.	Hand ladle	2330	.143		
none		1893	.110		
		437	.033	23.80	30.00
1 lb.	200-lb. ladle	2370	.139		
none		2050	.118		
		320	.021	15.60	17.80
1 lb.	200-lb. ladle	2178	.128		
none		2000	.119		
		178	.009	8.90	7.50

Mr. J. E. Stead writing in Prof. Sexton's Metallurgy of Iron and Steel under the heading "Heat Treatment of Gray Iron," notices two varieties of silicon in considering gray iron, high in silicon, chilled from the liquid state. One kind of which gelatinizes on solution in hydrochloric acid whilst the other does not.

In examining samples of over gray iron, mentioned by Mr. Pilkington in the paper just referred to, the writer

has found indications of a similar nature in regard to the silicon. It is quite possible that the properties of such iron may be due to the condition of the silicon or are more marked from this cause. This element is not uniformly high however, as some analyses in Table I will show.

The conditions under which this iron is produced are very interesting. The furnace is always working very hot and the iron being run slowly down to the beds, apparently becomes chilled whilst fluid and when cold presents a very wild fracture. Unfortunately, considerable variation is allowable in furnace conditions, for the production of this metal, but there are certain fixed conditions, the main one of which is that the burden is always light, carrying an excess of coke.

TABLE III.

Character of Slag.	Pure Silicon added.	Quantity of Metal used.	Transverse strength.	Deflection	Per cent Alteration in strength.	Per cent Alteration in deflec.
White	¼ lb.	50 lbs.	3160 lbs.	.310		
	none		3350	.333		
			loss 190	.023	5.7	7.0
White	½ lb.	100 lbs.	3000	.320		
	none		3300	.350		
			loss 300	.030	9.1	8.6
Dark	⅛ lb.	75 lbs.	3550	.325		
	none		3330	.315		
			gain 220	.010	6.6	3.1
Dark	½ lb.	100 lbs.	3430	.330		
	none		3100	.300		
			gain 330	.030	10.60	10.0

NOTE.—The test bars cover 36 x 2 x 1 inches.

With this fixed condition there is a certain amount of variation possible in the product of the furnace according to other variable conditions. If the slag be very limey (say 43.0 per cent to 45.0 per cent lime) then if the metal as tapped contain a normal amount of silicon (say 3.0 per cent to 3.5 per cent) the pig iron will usually have a good No. 1 or No. 2 fracture. With the silicon under 3.0 per cent the fracture will be wild and scattered and the more so, the lower the silicon contents. On the other hand, with a slag comparatively low in lime (say 35 to 40 per cent lime) and a similar burden as regards fuel, two products are again possible.

If the silicon be over 4.0 per cent the iron will be glazed and if under 4.0 per cent of good fracture. Under such conditions low silicon iron is not made.

The question thus resolves itself, more or less round the silicon content and it would seem that with rich limey slags there may under certain practical furnace conditions, not be sufficient silicon reduced to ensure all the carbon (or a sufficiently large proportion of it), to remain as graphite. The iron also carries a larger total carbon than is usual with the brand and there is consequently a greater tendency to form combined carbon.

It may also be that a portion of what silicon is present is rendered incapable of acting upon the carbon owing to the chilling of the metal in the liquid state and thus increasing the effect.

This and the microscopic examination are the lines on which probably further information can be gathered on this subject.

That there is something unusual in the condition of the elements in such iron is shown by the fact that remelting in a cupola does not remove the evil properties of the iron and in all probability it will be necessary to remelt in air furnaces to a higher temperature than the original temperature at which the metal was tapped.

Mr. Pilkington, who is well known, as an expert in blast furnace matters, has taken a keen interest in the matter for years, has made the subject his own, and will no doubt ultimately see the most interesting problem satisfactorily solved.

In a paper by Mr. A. E. Outer-

bridge presented to the American Foundrymen's Association the addition of ferro-silicon to the ladle is advocated and very considerable gains in transverse strength and deflection are shown as a few illustrations extracted from that paper and given in Table II will show.

Mr. Outerbridge however, points out that the use of ferro-silicon in the ladle may be better than the addition of extra silicon to the mixture on the cupola stage, as the silicon added as ferro-silicon readily abstracts any oxygen from the molten iron which may have been taken up from the blast in the cupola. Such oxygen, it is well known, has a very detrimental effect on the iron and is the cause often of trouble which is attributed to other causes.

The writer has made some experiments with ferro-silicon, which whilst not at all exhaustive may be interesting in the connection.

In the first two instances quoted in Table III the cupola was running on a light colored slag, whilst the last two instances are from a cupola on a dark slag.

The results are interesting rather as a comment upon the statement by Mr. Outerbridge that the good results may be due to the extraction of oxygen from the metal, than as decisive for or against such additions.

In the first cases, the iron being melted in a hot cupola on a light colored slag, indicating a sufficiency of coke and limestone for fluxing, the conditions are such as to reduce the tendency to absorb oxygen to the minimum, whilst in the second case the conditions are absent; in the former case the addition of ferro-silicon reduces the strength and deflection, in the latter increases them and it would seem as if there were some connection between the two.

It may be that since American iron is lower in silicon than English brands, and that higher melting ratios are more common there than here, combined with stronger blast; some considerable absorption of oxygen is a constant occurrence in their practice. Even if this be so, it is a question whether it would not be more economical to work with slightly lower melting ratios, with more flux on the charge, than to incur the expense for ferro-silicon to more than cover any economy obtained.

Manganese and sulphur are so connected together in the relation to cast iron, that they may for our purpose be considered together.

The presence of manganese in quantity in iron, has two principal effects, namely to increase the power of the metal to absorb carbon and to decrease the amount of sulphur held by the iron.

Whilst connected as a chemist with the manufacture of ferro-manganese and spiegels, the writer observed that in every case sulphur was practically absent in these metals.

The typical analyses given in Table IV will indicate both the properties referred to.

The usual effect of manganese is to

TABLE IV.

	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Manganese	30.00	40.0	50.0	60.0	70.0	80.0
Carbon	5.4	5.6	5.8	6.2	6.5	6.8
Sulphur	0.005	0.005	0.005	trace	trace	trace

TABLE V.

	Original Iron.	Melted with 16 per cent Spiegel to give 1.80 per cent in mixture.	Melted with 80 per cent Ferro Mn to give 1.80 per cent in mixture.	Original Iron.	Melted with 80 per cent Ferro Mn to give 9.0 per cent Mn in mixture.
	White.	Gray.	Gray.	White.	Gray.
Manganese	0.491	1.22	1.12	0.22	6.87
Sulphur	0.170	0.057	0.065	2.50	0.056

harden castings and to increase the shrinkage, but these effects can generally be neutralized by judicious adjustment of the silicon contents, whilst its power to make the metal more fluid and thus reduce the number and size of blowholes is of great use.

Sulphur, as is well known, tends to cause the carbon to assume the combined form and thus produce hard and brittle castings; it is now acknowledged to be present in cast iron as manganese sulphide if sufficient manganese is present to satisfy the whole of the sulphur, if not the balance is there as sulphide of iron.

The sulphide of manganese being very fluid has a tendency to float to the top more or less during cooling.

As this occurs on a large scale it is quite possible to use manganese in the form of ferro-manganese or spiegel, as a softener by removing the sulphur from the iron and thus at the same time removing the effect of the sulphur on the condition of the carbon.

This is only possible, however, in the case of very common iron.

Some very interesting experiments showing the effect of the addition of ferro-manganese to common iron, are described by Mr. T. E. Holgate, A. R. S. M. of Darwen, in a paper on this subject read before the Staffordshire I. & S. Inst. in 1892 and Table V is compounded from figures given in that paper.

Even without such external additions, the presence of very normal quantities of manganese (say 1.00 per cent) will insure the expulsion of some of the sulphur under favorable circumstances, and more advantage might be taken of the fact than is the practice today, especially where the foundry is worked in connection with a blast furnace plant and direct metal may be used.

Considerable quantities of sulphur might be eliminated by running the metal first of all to a receiver or mixer of suitable size and heated in a similar manner to that adopted in steel works practice.

The results obtained at Cargo Fleet and published by Mr. G. A. Wilson in a paper on the Talbot process* are very interesting in this respect.

The steel furnaces at this plant were ready before the mixer was finished and the metal was taken direct from the blast furnaces to the steel furnace.

TABLE VI.

	As tapped.	After 1 hour.	As tapped.	After ¼ hr.
Sulphur	0.070	0.038	0.060	0.03
Manganese	1.00	0.80	1.20	1.00

The sulphur contents in the iron before and after the mixer was used compare as follows:

Prior to use of mixer, sulphur 0.10 to 0.15 per cent.

After use of mixer, sulphur 0.049 per cent, thus showing a very considerable reduction.

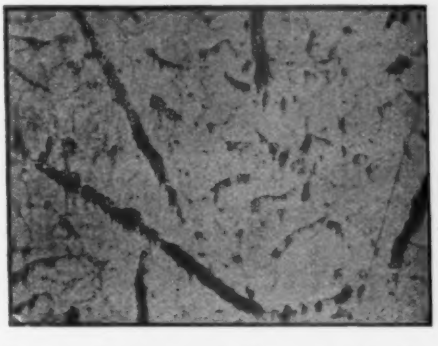


FIG. 1.—DERBYSHIRE (SHEEPBRIDGE) NO. 1, UNETCHED COARSE GRAPHITE IS SEEN. THE PHOSPHIDE EUTECTIC STANDS IN RELIEF.

Even in ordinary cases where metal has had to be held for a considerable time before casting, considerable reductions have taken place.

The two instances given in Table VI, which have come under my observation, and in which the metal had to be held for about one hour after

*West of Scotland I. & S. Institute.

tapping illustrate the same thing.

If the metal had passed through a mixer probably better results might have been obtained.

Phosphorus, in whatever quantity and form it is charged into the blast furnace is found entirely in the pig iron, and indeed ferro-phosphorus up to 20 per cent phosphorus has been made in the blast furnace in this country to the writer's knowledge.

It is present in cast iron partly as phosphide of iron and partly in solid solution in the iron.

The term solid solution is not very easy to understand to those who are not familiar with the work which has been done upon steel with the aid of the microscope, but an authoritative explanation of these terms may be found elsewhere, notably in Mr. Stead's paper on iron and phosphorus (I. & S. Inst. 1900) and we need not explain here.

The phosphide can be readily detected on an etched specimen of the polished iron, with a little practice; or without etching, by what is termed heat tinting. In this process the specimen is slowly heated and the succession of tints assumed by the constituents noted.

In this way when cementite has assumed a red color, phosphide of iron has a pale yellow tint and on continuing the phosphide at one period becomes salmon colored. This salmon tint is distinctive of phosphide of iron.

TABLE VII.

		I.			II.		III.		IV.	
	Pig Iron.	Large Button. Mottled.	Soft Crystals ex-Button.	Small Shot. White.	Pig Iron.	Small Shot. White.	Pig Iron.	Small Button. Gray.	Pig Iron.	Small Button. Gray.
Silicon	1.026	0.513								
Sulphur	0.150	0.055								
Manganese	0.800	0.795								
Phosphorus	1.460	3.960	2.76	4.88	1.44	5.73	1.35	2.88	1.42	2.032

The following three micrographs of Sheepbridge foundry iron published in a paper on the micro-structure of cast iron by Mr. O. F. Hudson, A. R. C. S. (Staff. I. & S. Inst. 1905) show the presence of the eutectic or mother liquor containing the phosphorus quite clearly and are reproduced by kind permission of Mr. O. F. Hudson and the Staff. I. & S. Inst.

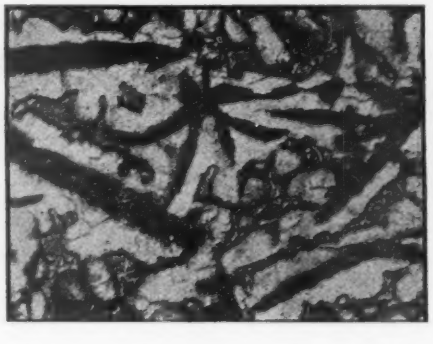


FIG. 2. — DERBYSHIRE (SHEEPBRIDGE) NO. 1 ETCHED WITH PICRIC ACID, SHOWS GRAPHITE, FERRITE AND PHOSPHIDE EUTECTIC.

FIG. 3. — DERBYSHIRE (SHEEPSBRIDGE) NO. 3, ETCHED WITH PICRIC ACID, SHOWS GRAPHITE, FERRITE AND PHOSPHIDE EUTECTIC.

Phosphide of iron is very fluid and on this account helps very materially in lowering the melting point of cast iron, as it melts considerably before the bulk of the iron. In virtue of this property globules of metal are occasionally found in iron containing much more phosphorus than the rest of the

metal. Such accumulations of phosphorus have been noticed by Dr. Moldenke in America and by Mr. Stead also.

Some months ago this matter was brought to my notice by Mr. Munnock who had found buttons containing very considerable percentage of phosphorus, occurring in cast iron.

Some of these figures are, I understand, to be published by Mr. Stead shortly and will be found to be very interesting.

For some time I was unable to obtain any specimens containing over two per cent phosphorus, but during the last few weeks I have been particularly fortunate in finding several very interesting buttons in pig iron.

All my specimens are from pig iron, none of them were very large, some indeed quite small. The analyses are given in Table VII, so far as I have had time and material.

Button No. 1 was found imbedded in a sample of pig iron, whose fracture perhaps merits description.

When the pig was broken, the inside was found quite rusty and dark colored, the only bright metallic portion being a thin layer round the exterior. The iron had been watered whilst still very hot and a crack had been produced in one side, through which apparently water had entered, cracking the interior of the pig, whilst leaving a shell of metal only round the outside. In the center of the pig was the button firmly embedded like a fossil and not occurring as in other cases in blowholes or near the surface.

A microscopic examination of these buttons would no doubt yield some very interesting results, and it is to be hoped that Mr. Stead will deal with this side of the question in taking the matter up.

At present microscopic outfits are not recognized institutions in most plants of this country, but at the present rate of progress in this branch of the study of cast iron the day will not be far distant, I think, when they will be the rule instead of the exception.

When one considers the matter closely, the microscopic examination of cast iron is merely a modification of grading by fracture.

The only difference being that the power of the human eye, which has its limitations, is reinforced so that the fracture may be examined as closely and minutely as possible.

It is a trite and true saying that if a thing is worth doing at all, it is worth doing well, and the advocates of judging and grading iron by fracture should be amongst the first to welcome microscopic examination also.

There is no doubt that in many instances in which doubt still remains, in spite of close analytical study, the microscope would be of great service, but before such equipments can be of practical use, a considerable amount of patient routine and trial work will be necessary, so that the operator may know and have confidence in his apparatus and results. It is therefore folly to wait until results are actually required, before commencing this work.

In conclusion, I am much indebted to my employers, the Sheepbridge Coal & Iron Co., and to Mr. Pilkington for kindly allowing me to use in certain cases, data obtained in their employment, and for assistance and suggestions from time to time.

GENERAL INDUSTRIAL NOTES.

The Morse Chain Co., having removed its works and offices from Trumansburg, N. Y., requests that all mail, express and freight be addressed to the company at Ithaca, N. Y.

The Standard Roller Bearing Co., located at Forty-eighth street and Girard avenue, Philadelphia, has purchased the entire property of the Pennsylvania Iron Works Co., which adjoins its present plant, thus increasing its working floor space to 500,000 square feet. The latter company will remove to some location outside of Philadelphia and continue the manufacture of gas engines and other specialties as heretofore.

British Foundrymen's Association

Annual Convention at Middlesbrough.

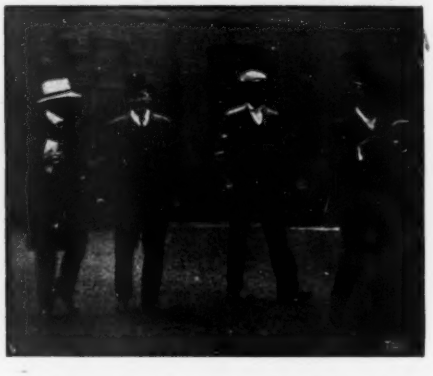
Wednesday's Proceedings.*

The proceedings were continued in the lecture hall of the Middlesbrough High School on Wednesday, Aug. 8, when the following additional members and visitors were present: Messrs. J. McPhie, Falkirk; W. Mayer, Dumbarton; James Smith, S. Shields; A. Hunter, West Hartlepool; G. R. Varley, St. Helens; E. Houghton, Chesterfield; J. E. Halbert, Chesterfield; E. Adamson, Seaton Carew; and A. Sixsmith, Leeds.

The paper on "Shrinkage from a Founder's Point of View," by Mr. W. Roxburgh, Kilmarnock, was read by Mr. Buchanan in the absence of the author. The chairman pointed out that arrangements had been made, enabling the author to deal in writing with any point that might be raised.

Mr. Mayer, Dumbarton, said he thought the author had put the thing so tersely and plainly that there was nothing left to discuss. The question of shrinkage was one involving considerable danger. He thought it was very desirable that foundrymen should be consulted by designers and draughtsmen on the subject, and designers especially should understand that there was a natural law and explanation of contraction, so as to impress it on their memory. In that way, the prevention of hollow castings would be to the benefit of the founder, and would probably be the means of avoiding many disasters now associated with large castings. It was a plain and practical paper constituting a most important contribution to foundry literature.

Mr. Mason said he was sorry to differ from Mr. Mayer, as he thought the paper was not so terse as it ought to be. The terms were not quite plain, and when the author spoke about shrinkage and contraction he seemed to be using two different terms, and regarding them as the same thing. West laid it down that contraction and shrinkage should be regarded as two different things. Shrinkage he had applied to those holes that they were all troubled with, while contraction was the reduction from the size of the pattern to the size of the casting when cold. They would see that contraction meant one thing and shrinkage quite another. Those in contact with a foundry making patterns were wise enough to make them with round corners, as they ought to be. The author said there was more difficulty with shrinkage or drawn holes with soft metals than with hard metals. Personally he took a different view, e. g., take malleable iron, or steel and they would see that there was plenty of trouble with shrinkage and holes. It was commonly said that soft metal gave more trouble than hard metal. His own experience was that in the gray iron of the foundry they got the most shrinkage. Irons melted two or three times over did not give so much trouble as iron melted fresh from the pig, and they always found that when the scrap stock got low, consequently they used more pig iron, they had



LEAVING THE MEETING. THE PRESIDENT, MR. PILKINGTON, ON THE LEFT.

*The first of the report was in the September number of THE FOUNDRY.

more trouble with shrinkage holes. Iron fresh from the cupola was especially troublesome. In conversation with Prof. Turner the professor expressed the opinion that the shrinkage was mostly due to what was called eutectic, that is metal below the freezing point separating from other parts of the metal. Graphite would freeze first and the iron was then eutectic. With regard to the parts that were said to be picked out with a knife, those would be in the center of the casting, and would be really graphitic or scaled. His own experience related to the casting of plates 5-16 thick. If they were casting a plate three feet long by two feet wide, the usual thickness would be 5-16 throughout, and they would add to that the thickness of the pattern. Then they would get the extent of the shrinkage. They would camber it in the mold and sometimes have to make two trials before they could ascertain the extent of the shrinkage. Even men with 17 years' experience could not foretell how it was going to come out. The present practice was to make the casting square and get it out in that shape, and during the cooling operation they would raise the box on its edge and begin stripping from the face after the lapse of from 12 to 17 minutes after casting. They made a point of never stripping in less than 12 minutes. They stripped about a foot square in the middle of the casting and watched the color. Usually it turned to a dark red, and they did not move it until it reached that color. When it got nearly black they began to strip. By this means they got the plate cool from the middle outwards, and their experience was that the plate never got bent. The question of thickness made no difference. As long as they cooled the casting from the middle outwards they had an effectual method of stopping a great deal of the contraction. The same thing was done with plates of a different kind. On the other hand, if they cooled plates from the outside they invariably had curves. With regard to ¼ inch thick plates, he thought the author must in that reference be speaking of shrinkage. His own experience was that if they cast plates at the uniform thickness of ¼ inch, they did not have any trouble with contraction or holes. But, if they had ¼ inch in one part and one inch in another part they would have the old trouble. He should add that if they were using new metal, say iron from the cupola, taking out a good deal of the sulphur from the coke they would have trouble with it. When the author spoke of the decarburization which took place in slow cooling he candidly confessed he did not know

INSPECTING A BLAST FURNACE.

what the author meant by that phrase. The paper was not so clear as they might have expected, and he hoped a good deal of discussion would take place upon it with the object of clearing up doubtful points.

Professor Turner said the subject was of very great importance to iron founders, and they were met at once with the difficulty of definition, as to what they meant by shrinkage and by contraction. There was a good deal of difference between the two, and apparently among American workers there were wide differences of opinion. But he thought the differences of opinion were not so great as the differences of definition. The difference between the two was put both by Keep and West. Keep was the best known authority on the subject and the earliest worker. Personally he

had adopted as far as possible Keep's definition. When he spoke of expansion and contraction he referred to those changes with which they were familiar in ordinary metals and ordinary material such as iron rails. Those heated to a certain temperature would expand. But when they were cooled to the original temperature they recovered their original size and shape. When they heated cast iron it would expand, when they cooled it it would contract. If they cooled it to the same temperature there was no differ-

A GROUP OF BRITISH FOUNDRYMEN.

ence in the size. But if they took a piece of clay in a damp state and dried it, after cooling it they would find it had contracted, but it would not recover its original volume, and they therefore called that shrinkage. If they baked it, it would contract still further and still would not recover its original volume. That would well illustrate the difference. They called that shrinkage which represented the difference in volume between the original and the final. They took no account of the plus and minus, though there was a good deal of both, but they took the net result. The author had laid it down that metals shrank most according to their density. But he thought after further examination he would find that was not correct. Platinum or gold, which were very dense metals, did not shrink abnormally, neither did lead. Metals shrink as a rule according to their melting point, and the higher the melting point naturally the greater fall of temperature. Therefore, the amount of contraction depended upon that fall. The higher the melting point the greater the shrinkage. Steel would shrink more than cast iron and cast iron would shrink more than the majority of metals with a low melting point. Then shrinkage depended also upon the size of the castings. They were well aware that a thick bar of cast iron would shrink less and a thinner bar more in the direction of length, but if they had a thick bar at the top, and a thin bar at the bottom of a frame, it would contract more where the edges were thin than where they were thick. They had made a number of observations at the Birmingham University in recent years, and had cast from the same crucible at the same temperature, and at the same time thick and thin bars. They were able to do that by a very simple arrangement. They ran the metal into a bar a quarter of an inch square, and out of the same mold with the same degree of dampness, they got half an inch. Therefore the one bar had four times as much metal in it as the other. Practically they never found the two bars taking the same length. But it was a curious fact of which he was unaware until the last few years, though it seemed to be a universal law, that it did not apply to copper. In regard to iron, invariably the thin bar would contract more than the thick one. But in copper the reverse was the case. The thick bar contracted more than the thin bar. Again if they took brass, the thin and thick bars would contract at the same rate. He referred to the brasses most commonly used for foundry purposes. Obviously it was a question worth considerable study by the iron founder. At the same time it could be studied without any extensive apparatus, or without any experiments requiring a large amount of time. He knew no class of experiment that foundrymen could conduct with less trouble and time than shrinkage tests, either by Keep's apparatus or something similar. If they had iron that shrank much they knew the metal was hard.

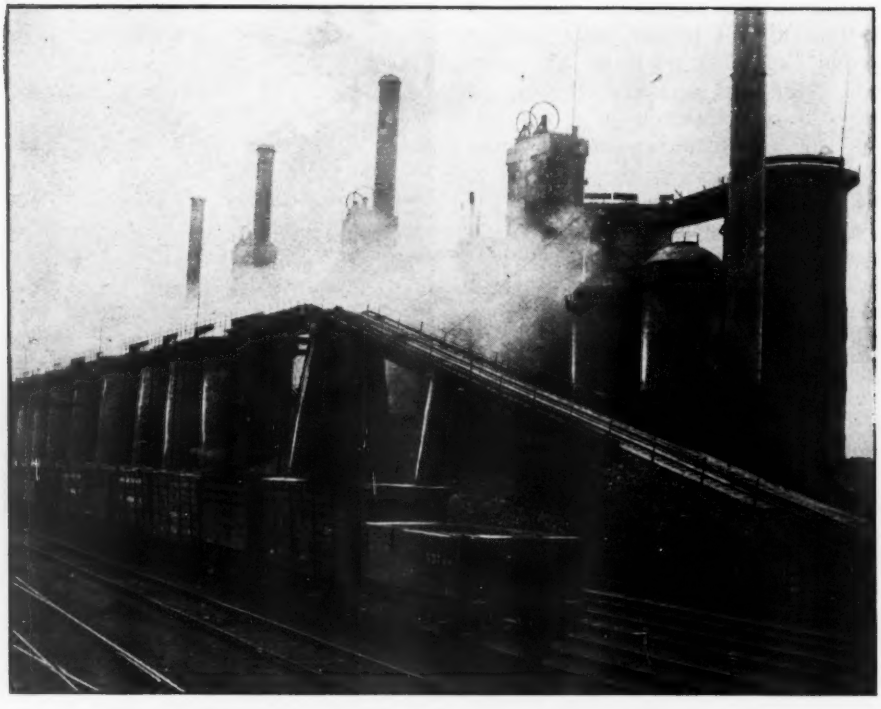
Hard metal shrank the most, and soft metal the least. If they had pig iron to deal with, and did not wish to take time for ordinary analysis, but wanted to know what it would do in the foundry if they would melt six or seven pounds in a crucible, and apply the shrinkage test they would ascertain the proportion of silicon, and the mechanical properties. Another interesting fact was that gray cast iron expanded during solidification. If phosphorus was present they got a second expansion while in the solid state. If it was very gray they would get a third expansion in a quarter-inch bar, and it was nearly five minutes before the iron again contracted to the volume it originally occupied. If allowed to expand to the end, they found that from the first few minutes the iron was getting bigger, then it came back to its original size, and then it went on contracting. He had a few copies of a paper he had read on that subject, and he would be very pleased to let anyone really interested in the matter have a copy of the paper. (Applause). The expression "shrinkage holes" very generally covered several kinds of trouble. One to which Mr. Mason particularly referred was the spongy condition in which there were often portions of graphite, which were due to internal contraction, as Mr. Mason had explained, in iron that was too soft for the purpose. The interior of those holes had the appearance of inflation. In other cases they sometimes found the holes smooth, and of dark blue color, or nearly black. Those were usually due to the iron being too hard, and very often to the presence of sulphur. They would get the shrinkage holes if the iron was either too hard or too soft. If they cooled quickly, they would prevent the formation of those holes, but it was better to make the composition right. He did not agree with many of the things put forward in the paper.

Mr. F. J. Cook (Birmingham), said that for a number of years he had given a great deal of attention to that subject, and he had found it useful in many ways. He also disagreed with the terms used by the author. He personally generally spoke of "shrinkage." Shrinkage did not always follow. Iron might give the same shrinkage by Keep's test, but if they tested it by the Keep test they might find it spongy in one place, and solid in others. In some of the refined irons run

MR. ELLIS GIVES A FEW FOUNDRYMEN A WRINKLE.

from a special furnace, and not run hot enough they had found oxides formed there, and that was a big source of trouble to a man making special castings. The analysis might be right, and the shrinkage might be right, and yet it gave that trouble. He had been able to eliminate irons that gave a lot of trouble. He had one before him with a test for hardness. The combined carbon was 0.84 to 0.72. The graphite 2.14 to 2.2, the silicon 1.4 to 1.26. The phosphorus, and manganese altered slightly. The result was that while in the one case the iron was exceptionally good, in another case it was absolutely rotten. In the one case they had a tensile test of from eight tons to eleven tons. The analysis was quite near enough to show both the iron as of the same quality,

and the shrinkage also would give the same result. Yet he had a lot of trouble with the castings which came from them. It was not until he appointed the Keep test that he was able to find out the reason of the different behavior. It was necessary to cool gradually, and to apply the whole of the mechanical tests, not taking one merely. The shrinkage test was an exceptionally good one for cutting and hardness. Irons would vary to a large extent, still they would do so within limits. With reference to the sinking of the parts that was a matter which draughtsmen could not always get over in their designing, because they were bound to have different thicknesses. They had all sorts of complaints against draughtsmen, but he had a fellow feeling for them, because he was



A View at the Bolckow Vaughn & Co.'s Works.

lots of things, but they had to be very careful in applying it between the thick and thin bar, and even with the differences they would get through careless molding. Keep's test might be insufficient. It might show only a few thousandths difference in the metal. He found edge shrinkage very useful, but the cores did not always run evenly. At present he was unable to form any invariable rule, but at the same time there were limits to which they could work very narrowly, by following Keep's rules, and it gave the best results afterwards. He found if he got 0.15 for silicon iron, it would be right for a draughtmen as well as a foundryman. It was the work of the foundryman to devise means for getting over their troubles, and a great many of these troubles could be got over. It was very largely a question of right cooling. His experience was that castings ought to be got out of the molds as soon as possible, and in that way they were able to cool quickly from the surface. One-eighth of an inch taken off in that way gave them a closer surface. At the same time, if they cooled more slowly they got a better surface. He should have liked the author to have given them some more practical hints as to how to deal with

the shrinkage. In that respect the paper seemed to be lacking. But perhaps he would include them when he revised his paper.

Mr. P. Longmuir, said he must admit that he was somewhat in a fog at present. The fact has been mentioned by Professor Turner that shrinkage was a question of the melting point. It had been his own good or bad fortune to have a good deal to do with aluminum, as well as with steel castings, but his greatest trouble had been with aluminum, or its alloys, which melted at a heat in the neighborhood of 700 degrees. It seemed to him to be better to regard shrinkage as liquid contraction, and contraction as occurring entirely in the solid. If they looked at it in that way feeding could be put entirely on a scientific basis. Feeding was designed to supply liquid shrinkage, and so to remove what he understood Mr. Roxburgh's vacuum holes to be. Feeding was only efficient down to solidification; after that its action ceased. With regard to vacuum holes, it was once thought that the holes made in the top parts of a steel ingot were a sort of oxide containing nothing. As a matter of fact they contained gases including nearly 75 per cent of hydrogen. He did not see how any casting containing that could be described as having a vacuum. If there was a hole there must be gases in it.

Mr. R. Buchanan (Birmingham), agreed with Mr. Longmuir's definition of the two contractions as being more exact, and more definite than any they had had in the discussion. In the Birmingham district they talked of liquid contraction as sinking, while Scotchmen usually spoke of it as drawing. But when they came to the contraction of the metal after it had been in the solid form, they called it, of course, contraction. He believed there were as many different opinions as to what caused sinking or draw holes as there were causes for them. In the foundry they often met with a great difference of opinion as to whether a certain hole was a blow hole, or a sunk hole. The rule they had always applied whether the hole was shrinkage or a draw hole was the color test. When they saw in the hole a light shiny surface he usually put that down to blowing. When it was dark, he put it down to sinking or drawing. His own explanation was that the gases from the coal gave a skin to the metal, and had entered into that hole, and darkened its interior and so darkened the castings. He thought everybody had been avoiding the question of warping.

F. WESTGARTH.

There was no subject whatever about which there was less known. It was a thing about which he knew very little. He had sometimes exercised his ingenuity by saying to himself "such and such a pattern will behave so and so." He had not kept statistics, but he knew that very often he was wrong. His errors reached a considerable percentage, and a large number of people were very chary in saying as to how the shape would come out. That backwardness in expressing opinions was a national characteristic, but being British foundrymen they were disinclined to say plainly that they did not know. It would be of the greatest possible interest and profit, if one could clearly indicate how a casting was going to come out of the sand. But their difficulty in offering such prediction arose simply from the fact that their ideas as to crystallization and contraction were in a very elementary stage at the present moment. Why a thin casting should contract more than a thick one, and why the thin portion should contract more than the thick portion, and so cause warping obviously

arose from the fact that the thin metal cooling in a less space of time had its crystallization in a more finely divided state. Those crystals were packed more closely together, which otherwise would have occupied more space, and they expressed that by saying that they had contracted more, because the heavy castings have larger crystals, and larger graphite occupied a denser position.

W. ROXBROUGH.

Those things were conditioned by laws of which they knew very little, and until they knew more about them they were likely to be confronted by shrinkage holes, and warped castings of which very few could predict how they would come out of the sand.

The chairman regretted the necessity to close the discussion. He was very glad Mr. Longmuir laid down his definitions of contraction, and shrinkage which were probably more clear to the ordinary foundryman than any they had yet had. He should have liked personally to hear more about relative behavior of hard and soft metals, which was a most complicated subject. Mention had been made by Professor Turner of the development he had often seen, in which metal being too gray produced those spongy parts. There was another side of the subject, relating to the use of the hard metals. Then with regard to the relative responsibility of pattern makers, and foundry managers he quite agreed with the author, that whatever the pattern maker had to say or do about the patterns, the foundry manager should lay down the final rule as to how the pattern was to be made. It was true that involved responsibility. But in his own works it worked out very well. He thought very good results would follow, if further works were written on that subject.

A hearty vote of thanks was accorded to Mr. Roxburgh for his paper.

Mr. Meyer expressed the hope that the subject would be further discussed in the trade papers. Mr. Finch explained that he should report the discussion to Mr. Roxburgh, who would reply in their own copy of the proceedings.

Mr. Cook expressed the hope that those who had taken part in the proceedings would have the opportunity of correcting their own proofs. (Laughter.)

The chairman caused some amusement by recalling the remark of Dr. Raymond at the meeting of the Iron and Steel Institute in London, that they desired to report not what members had said but what they would wish to have said. At all events, he thought they should lay themselves out to receive written communications on those subjects, and to print them. There might be some little difficulty about it, but that must be the line they would go upon.

Mr. Swinden proceeded to read his paper on the subject of "Some Methods of Measuring High Temperatures"—Mr. Swinden is a Mappin medalist, and Associate in Metallurgy of the Sheffield University, Royal Exhibition Scholar.

Mr. Buchanan opened the discussion with a story about Lord Kelvin, who twenty years ago was Sir William Thompson. At that time he was a professor in Glasgow and was visited by a party of students. The visitors were looking at an illuminated address presented by the shareholders of the first

American-British submarine cable. The first cable, Sir William explained, was not altogether successful. The promoters painted the prospects rather rosily, and Lord Kelvin took them to task in the newspapers pointing out that what they were proposing to do was impossible, with the then advance of science. The history of the project justified his misgivings. They were at first unable to read any messages, for the reason that the instruments receiving the current were too crude and would not record. Sir William made it a success. The shareholders did not care to come to him but expressed their feelings by means of the illuminated address. Lord Kelvin told the students that a very great lady, whose word was law, wrote to him, and asked him what he would do, with the result that he set about, and invented a galvanometer, which recorded the messages. The speaker said the story linked Lord Kelvin with the late Queen Victoria in a very charming way.

Mr. P. Longmuir said the author's paper was a very valuable statement on the question of increasing temperature. Some people asked what was the good of measuring temperature, but the same question arose with analysis, and with the microscope. In dealing with special steels, for certain varieties the task would be a hopeless one without the pyrometer, or some other method of measurement. With cast products a large proportion depended for their success not on their composition, but on their after treatment; therefore the success depended upon a definite, and exact measurement of temperature. In carbon steel castings, experience had shown that for the best results they wanted, with a mild steel, to anneal them well, keeping them for three days in a temperature of 900 degrees. If they did that, there was no reason why, within possible limits, they should not secure a maximum stress of 25 to 28 tons elongation, or even 30 to 35; he had had some which stood 38 tons. A good deal was said about brittle steel, and there were many reports of propeller shafts failing, and crank shafts breaking. But ten years ago he found that if a steel, brass, iron, or any foundry alloy was not overheated, and that that alloy was poured at the same heat, they got the same tensile results. A steel tapped at 1,550 to 1,600 degrees stood a maximum stress tonnage per square inch of 35.8, and an elongation test of 12.5, while it stood 68 reversals. In the case of a forged steel at the same degree, it was bent backward and forward to 546, while a cooler one at

THOMAS MCFARLAND.

1,470 to 1,500 degrees gave the same properties in the tensile test, and broke on 172 reversals. He had no doubt that though he had no personal interest in that question of casting temperatures, the majority of the mysterious failures could be traced to that cause. That was one direction in which Mr. Swinden had given them food for thought, he had given them many methods to choose from, and as far as accuracy was concerned he did not suppose there was much of any of them, as a matter of choice. It was mostly a question of convenience, and initial cost. The pyrometer Mr. Poole illustrated was a very cheap thing, costing only six or seven pounds. He had used it at the National Physical Laboratory, and got results

equal to one of the most expensive instruments.

Mr. Mayer said he would like to know if Mr. Swinden had ever applied any of those instruments to manganese bronze. This metal was getting very important for propellers, and many other things. It had been tested up to 28 tons to the square inch, and 15 per cent elongation. He noticed that Mr. Swinden had ap-

T. J. Cook.

plied the instruments for measuring at various stages of heat.

Mr. Adamson complimented Mr. Swinden on the grasp he had got in the use of the pyrometer. He had personally made some tests, at the technical school, and the difference in degrees between the Vanner pyrometer, and the Chatelier, was very small. That was a test for optical instruments only. The speaker pointed out that the great desideratum for most foundrymen was to get the temperature at once, without any elaboration. He rather regretted that the author did not lay stress upon the optical instruments which he personally considered of great value to the foundryman, because of their quick and ready application.

The chairman said that for a great many years he had used pyrometers, and had tested a considerable number for taking the heat of the blast furnaces. He finally decided on the thermocouple of the Roberts-Austen type. That recorded the heat at some distance away from the furnace, and in any furnace whether blast or gas could be switched on for the use of the managers, foremen and gasmen, on the spot. That pyrometer had been in use for some years, and had been a source of greatly increased regularity in the blast furnace. They not only got the temperature, but they got a record of what the men were doing during the twenty-four hours in stove changing, and charging the furnace, etc. That seemed to be a use not originally contemplated, but it was very valuable to show the action of the men.

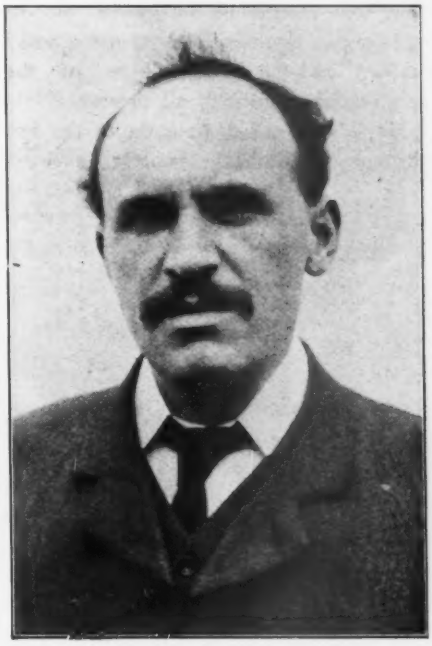
Mr. Swinden replying said he had had no experience in the manganese line, but the instruments would do as well for manganese-bronze. With regard to optical instruments there was always the question of the black body. He thought Mr. Adamson had misunderstood his remark about optical instruments. He did not mean to convey that there was any error in them. He felt there was a great field for the development of that class of instrument, much more than in the thermocouple, and the resistance pyrometer in the foundry. He had made experiments with a Chatelier, and the Vanner, and the difference was only 10 degrees in 1,200. They had three or four tests, and they varied only 10 to 15 degrees. They all had their advantages, and disadvantages; for instance, the Vanner had to be standardized every morning, while the themocouple would not require that, and that was an advantage which the others had not. The idea was to choose an instrument most suitable for a particular line. He hoped when the paper was printed, it would enable anyone interested to take out the instrument he considered most suitable, and follow up that. Naturally if a man had specialized one instrument he considered it the best. (Applause.)

The chairman invited the meeting to

pass a hearty vote of thanks to Mr. Swinden for his paper, which represented an enormous amount of labor and which he had no doubt when printed would prove a very valuable contribution.

The last paper read was by Mr. E. Houghton (Chesterfield), "Notes on the Chemistry of Cast Iron."

Professor Turner said he should wish to refer to several points when he had read that interesting paper more carefully. With regard to the exudations, attention was called to that matter twenty years ago by Sir Frederick Abell who had collected some samples. Those exhibited to himself by Sir Frederick were very beautiful, and about the size of broad beans. They consisted chiefly of sulphate of iron and were very pretty. It was some years afterward that he saw the exudations in the form of phosphite. That could be obtained by taking gray phosphoric iron and placing it in the casting muffle or similar apparatus at a temperature of 950 or 1,000 degrees. The phosphorus would come out and leave behind what was practically a hollow sponge. A great deal of the phosphorus would come out like little peas. With regard to microscopic observation, it had been said that this was only grading by fracture brought to a finer degree. Probably very few people knew how long microscopic observation had been carried on. But those who read Reinjener's (?) book dealing with the conversion of white iron into gray and the production of steel would find that so long since as 1720 the microscope was used for the examination of steel. In one of his drawings that author gave a sketch showing the structure of mild steel which would correspond not at all unlike the pearlitic structure which they recognized in ferrite and pearlite. It was doubtful whether he understood all that was shown by his drawing. The only advance in recent years were those improvements due to Sorby, of great importance, dealing with the preparation of the surface, the preparing of the smooth pieces and the etching of the surface. In the laboratory of the foundry it would be easy to introduce a microscopic outfit at small cost. It was simply a question of price. For twenty pounds they could get everything necessary for a foundry. They did not require a magnification greater than 75 to 100 times. A man could train his eye to learn what he saw in the microscopic examination, more quickly than in ordinary testing. The latter was a long process. The microscopic test was a short one. He looked forward to the time when practically all foundries would do their own shrinkage and microscopic tests and send their analysis out to be done when they required it.



R. MASON.

Mr. Adamson said the author had referred to the introduction of ferro-silicate into ladles. He had personally completed some experiments in the same line. But he did not quite agree with the reason given by Mr. Houghton. He thought the introduction of ferro-silicon in the cold state into the ladle slightly chilled the metal and increased the combined carbon. As to ferro-manganese being a softener he could not quite see how that could be. He himself showed in the paper given before the institute

last May that 1.8 of manganese gave a gray fracture. It was the proportion of manganese which gave a gray fracture, and the inference was that if they doubled the manganese there would be further grayness.

Mr. F. J. Cook remarked that carbon was of the greatest importance to foundrymen where high pressure had to be used, and if the author could give some idea how to produce or govern that in any way in castings so as to get a small grained carbon, it would be of the greatest importance to all present.

Mr. Meyer called attention to the importance given in the paper to the use

JOHN E. STEAD.

of the mixer. He would be glad to know what was the lining used in the mixer, and how long was it effective in desulphurized metal.

The chairman said, referring to Mr. Adamson's remark, that in certain foundries they used two to three per cent of manganese, producing very gray fractures. There were two districts where that practice was quite prevalent.

Mr. Houghton replying to the discussion said his paper was written as much with the object of eliciting as giving information. He was especially obliged to Mr. Turner, and he quite agreed as to the importance of micrographic outfits in the foundry. They did not imagine that all the difficulties in the foundry could be solved by micrographic work. Nor did they expect everything from analytic work or mechanical testing. All three coming together would have their proper usefulness. Referring to Mr. Adamson's remark, his own tests had not been sufficiently extended for him to be dogmatic, but there seemed to be something in the statement that the good effects were due to the abstracting of oxygen from the metal. In his own experiments the ferro-silicon in the ladle did not appear to chill the iron at all, but it appeared to make it brighter. It was particularly noticed that the metal was clearer, and brighter if anything. The results obtained by Mr. Adamson were probably due to the fact that a certain amount of ferro-manganese was allowed to cool in the crystal form, and in that way got into the ladle. He could not suggest any better method. He thought the meeting would benefit by the study of the paper given by Mr. Pilkington on the subject last year. As to the life of the mixer, he was referring to the one in use at Cargo Fleet, which they would see that afternoon, and which he had no doubt would have a very durable life. There were means of taking off any slag that might form, and the metal was not likely to be any more injurious to the lining than in many other cases with which they were familiar.

At the suggestion of the chairman thanks were accorded to Mr. Houghton for his paper, and a vote of thanks was accorded to the governors of the High School, on the proposition of the chairman, seconded by Mr. Buchanan, for kindly placing the meeting room at the association's disposal. Thanks were also accorded to Mr. Stead, Mr. Westgarth, and other gentlemen who had assisted in facilitating visits to the works and in completing other arrangements.

This concluded the proceedings, and the members were afterwards photographed on the lawn outside the school.

The third day of the conference was devoted entirely to the visitation of works, the establishments visited during the conference being, Messrs. Bolckow Vaughan, Ltd., Cargo Fleet Co., Ltd., Richardson, Westgarth & Co., Ltd., and others.

METALS IN FOUNDRY PRACTICE

Devoted to inquiries from Practical Foundrymen on subjects relating to the Melting and Using of Cast Iron, Malleable Iron and Steel.

The following experts answer questions in this department:

W. J. Keep, Cast Iron.

J. B. Nau, Metallurgy of Steel and Steel Castngs.

Dr. Richard Moldenke, Malleable Castings.

We have also made arrangements with several others to act as special contributors. All inquiries should be addressed to the Editor of THE FOUNDRY, and they will then be forwarded to those in charge of the different subjects.

CAST IRON NOTES.

BY W. J. KEEP.

WHAT METAL IS BEST FOR CHILLS.

Question:—What mixture of iron or steel would you recommend for making chills to make small castings? These castings to be 50 to 200 to the pound. These chills will have to stand very hot metal. The thickness of the castings would be about ⅛ inch and 1 to 1⅛ inches in length.

Answer:—The iron that you use for the castings will make the best chills. A light coat of mineral oil mixed with plumbago is best for the chilling surfaces. For castings as heavy as bedstead unions the chills will make 1,000 castings before pitting so as to destroy them. Your iron should be very soft with silicon towards 3 per cent.

TO REMOVE A CHILL FROM A CASTING.

Question:—Some of our competitors are laying a screw in the mold and casting iron around it and then turning the screw out when the casting is cold, leaving a cast iron thread. What kind of a coating will prevent the iron from adhering?

Answer:—Oil the screw and dip in parting sand. You will have more or less trouble with blowing, but thorough venting and a little practice will make good castings.

REVIEWS.

ON THE DISTRIBUTION OF SULPHUR IN CASTINGS.

STAHL UND EISEN, No. 15.

As the result of an extended investigation on this subject, it has been found that the sulphur in a casting rises upward as the piece sets, or rather, follows the highest temperatures. In doing so it collects at the point where the highest temperatures remain longest. It is therefore of considerable importance whether a casting is poured from the top or the bottom. A series of test bars of various diameters cast vertically gave the following results: Bars of 0.8″ diameter were practically uniform in their sulphur content. With an increase up to 1.2″ in diameter, the top of the test bar contained 0.015 sulphur, more than the bottom. With a diameter of 1.6″ this difference ran up to 0.023. The result of this and other tests indicates that castings of 1″ and under can be cast top or bottom without any appreciable difference in their sulphur. But when heavier can show material differences. Thus a casting of 1.6″ thick, with the sulphur in the iron originally at 0.12, showed 0.131 in the top, and 1.108 in the bottom, when the casting was poured from the top; and 0.137 at the top, and 0.102 at the bottom, when the casting was poured from the bottom. The difference in height in each case was about 30 inches. A further series of tests along similar lines would indicate that for heavier classes of castings in which the sulphur content has to be watched closely, the bottom pour is preferable, as it promotes a more uniform distribution of the sulphur. A further interesting point is that with a large casting in which there are sudden changes in thickness, it has been noticed that at the top of a heavy portion and just at a thinner part produced by the intersection of a core, the sulphur content was found to be 0.40, while the thinner part was but 0.12.

THE FOUNDRY

PUBLISHED MONTHLY BY

THE PENTON PUBLISHING CO.

CLEVELAND

BOSTON DULUTH CHICAGO

CINCINNATI NEW YORK

PHILADELPHIA

PITTSBURG

The subscription price of THE FOUNDRY is $1.00 a year to points in the United States, Canada and Mexico. To Great Britain: Eight Shillings. Single copies 15 cents each.

Change of advertising copy must reach this office on the 10th inst. preceding date of publication.

The Cleveland News Company will supply the trade with THE FOUNDRY through the regular channels of the American News Co.

European Agents: The International News Company, Breams Building, Chancery Lane, London, E. C., England.

Practical articles pertaining to the trade in all its branches are solicited and will be paid for.

When sending articles be sure to place your name and address on the article and on the drawings.

Entered as second-class matter at the Post-Office at Cleveland, Ohio.

PRINTED IN AN OPEN SHOP.

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TRADE OUTLOOK.

The foundries in general continue to be fairly full of orders, the malleable foundries in particular, and it is very difficult indeed to get deliveries on malleable castings. Most steel foundries also have their output sold for a considerable period in advance. The light gray iron foundries appear to be as busy as the malleable and steel foundries, while the heavy gray iron plants report a moderately satisfactory condition as to the orders upon their books.

The raw material situation in the foundry industry is still at a high price point, with no apparent prospect of lower prices in the immediate future. Both scrap and pig iron have advanced from time to time, until at present southern iron is selling on a basis of $15 Birmingham, although some furnaces are asking $15.50 to $16 for No. 2 foundry. Northern quotations for No. 2 foundry are $20.50 for furnace delivery at valley furnaces.

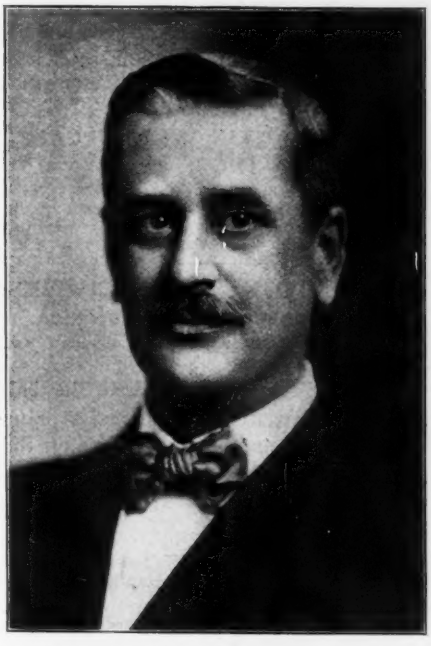
The foundries which employ chemists in all cases have an advantage over those who do not, as frequently off casts or No. 3 iron can be purchased from 50 cents to $2.00 under the market and by judicious admixture with other brands can be worked up into the best grades of merchantable castings.

It is evident that the ore shipments this year will not equal the high level predicted or desired, and hence with a somewhat curtailed ore supply, the production of the furnaces will be curtailed or limited to such an extent that if the present volume of business keeps up, there will be very little opportunity for much of a reduction in prices in the raw materials used in the foundry.

The coke situation is reported somewhat better than the pig iron situation, and foundry coke is now quoted at from $3.60 to $3.75 in the Connellsville region.

AMERICAN FOUNDRYMEN'S ASSOCIATION GROUP PICTURE.

Those who attended the Cleveland convention of the American Foundrymen's Association will remember that a very good group picture was taken on the steps of the Chamber of Commerce, and the committee of arrangements inform us that there are still several prints of this group on hand which were made up by the artist, which can be obtained for $1.50 apiece. THE FOUNDRY will be very glad, indeed, to forward the orders of any who may desire these pictures.



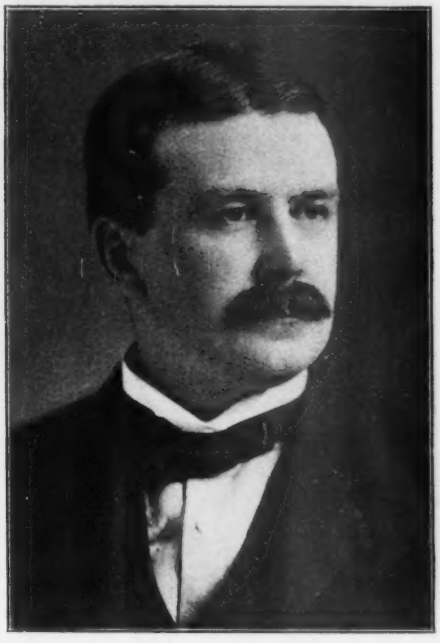
S. T. JOHNSTON, PRESIDENT THE FOUNDRY SUPPLY ASSOCIATION.

WINONA TECHNICAL INSTITUTE.

The foundry department of the Winona Technical Institute, which is under the wing of the National Founders' Association, has been opened and the school is ready for operation. We expect later to publish a more extended article dealing with the equipment and arrangement of the school, as all connected with the foundry industry are interested in all institutions for teaching foundry subjects.

FOUNDRY SUPPLY ASSOCIATION

All who have followed the affairs of the American Foundrymen's Association will remember that at the Cleveland convention there was an extensive exhibit of foundry supplies and equipment conducted under the auspices of a local association known as the A. F. A. Exhibit Association. This method of handling convention affairs has become common among other organizations and practically all of the leading associations of the country have affiliated with them supply men's associations.



E. H. MUMFORD, FIRST VICE PRESIDENT.

Recognizing this fact, a meeting was called at the Cleveland convention at which the members of the local association and all of the other supply men present were represented. This resulted in the formation of a supply association. Officers were elected and to a committee the task of drafting a constitution was delegated.

A joint meeting of the supply men and members of the local foundry-

men's association was held at the Art club in Philadelphia on Monday, Sept. 10. Those present at the meeting were: President S. T. Johnston, Vice President E. H. Mumford and Secretary H. M. Lane, of the supply association; Howard Evans, Dr. E. E. Brown and Henry O. Evans. The constitution was approved and arrangements were made for the secretary to distribute printed copies. Many other subjects were discussed, including the advisability of incorporating the organization.

It was voted to leave the matter of

E. A. KEHLER, SECOND VICE PRESIDENT.

the local entertainment committee for the 1907 convention open for the present, the committee to be arranged for at the next meeting of the Philadelphia Foundrymen's Association, Oct. 3. Arrangements were completed while Messrs. Johnston and Lane were in Philadelphia for securing a suitable site for the exhibit for next year, and other preliminary arrangements were made. The fact that the supply association will relieve the officers of the American Foundrymen's Association of much of the detail work of raising funds and looking after entertainment features will leave Dr. Moldenke and the other officers of the A. F. A. free to devote more time to securing strong papers on foundry subjects and it is certain that next year's convention will be marked by the reading of many very valuable papers and by important discussion upon subjects of interest to all classes of foundrymen. Philadelphia is the birthplace of the association.

A large number of firms have already joined the association and copies of the constitution will be mailed to other supply men. It has been decided to hold the charter membership list open for a short time so as to give a larger number of firms an opportunity to join as charter members.

OPEN-HEARTH STEEL CASTINGS.

The regular installment of W. M. Carr's series of articles on this subject had to be omitted this month, on account of the fact that the cuts did not arrive in time.

ASSOCIATIONS AND SOCIETIES.

British Foundrymen's Association.

F. W. Finch, Kingston House, Lonsdown Rd., Gloucester, Eng., Secretary.

In this issue will be found the balance of the report of the annual meeting at Middlesborough, and several of the papers read. The president's address and some of the other papers will be published later.

New England Foundrymen's Association.

Fred F. Stockwell, Secretary, care of the Barbour-Stockwell Co., Cambridgeport, Mass.

The New England Foundrymen's Association, after successful outings during the summer months, resumed its monthly meetings on Wednesday, Sept. 12, at the Exchange Club, Boston. The meeting was called to order at 5:20 p. m., Vice President W. H. Bense in the chair. Application was received from the Milford Iron Foundry Co., Milford, Mass., and it was unanimously elected to membership. Appropriate resolutions on the death of George B. Buckingham, were adopted.

A unanimous vote of thanks was ex-

tended to Mr. Henry A. Carpenter for his efforts in making the August outing held at Providence one of the most successful the association ever held.

Vice President Bense stated that the executive committee had secured some of the best and most prominent men connected with the foundry industry to address the association during the coming season, and urged the members to renew their efforts in increasing the membership and attendance at the meetings.

The objects of the association are the advancement of the interests of foundry operators, the promotion of mechanical and industrial interests, the collection of proper information connected with the foundry business, and the encouragement of harmony and uniform customs among its members. The association now has a membership of one hundred and twenty representative concerns of New England, and it is the desire of the officers to induce all foundrymen who are not affiliated to join.

After a short recess the meeting adjourned to dinner, after which the chairman introduced Mr. E. H. Mumford, of Philadelphia, who gave an illustrated talk along the lines of recent molding machinery and methods.

Philadelphia Foundrymen's Association.

Howard Evans, Secretary, care J. W. Paxson Co.

The entertainment of the American Foundrymen's Association, which is to hold its annual convention in Philadelphia next June, was discussed at a meeting of the local association of that city at the Manufacturers' Club, Sept. 5. It was estimated that about 1,000 persons would attend, and at $3.00 a head something like $3,000 would be required for extending proper hospitality. After a rather informal discussion it was finally decided to refer the whole subject to a committee to be appointed by the president, and which will be named at the next meeting. At a collation which followed brief remarks were made by several members on the present pig iron situation, from which it appeared that, because of labor troubles many of the Philadelphia foundries are not turning out more than 70 per cent of their capacity, and that, if they were all working full-handed, the demand for pig iron would be even more embarrassing than now and prices, in all probability still higher. The opinion was expressed that October is likely to prove a worse month for the foundrymen than September.

Philadelphia Foundry Foremen.

W. P. Cunningham, Secretary, care American Bridge Co., Pencoyd, Pa.

The Associated Foundry Foremen of Philadelphia and vicinity held their nineteenth meeting, which proved to be the best held to date, on Monday evening, September 10. First, there was the transaction of the regular business and the election of W. P. Cunningham as secretary to fill the unexpired term of J. B. MacMeekin, who had been forced to resign on account of leaving the city.

H. M. Lane, editor of THE FOUNDRY, Cleveland, was present, and gave a short talk on the arrangements being made for the convention of the American Foundrymen's Association and the Associated Foundry Foremen, which is to be held in Philadelphia in the latter part of May, 1907. The Philadelphia Foundry Foremen are making every effort and laying all the plans possible to assist in making this affair a great success.

F. C. Everitt, of the J. L. Mott Co., next read a paper on pattern storage, which was quite extensively discussed. W. O. Steel, of the Bateman Mfg. Co., also read a very interesting paper on a power attachment for a core machine.

AMERICAN FOUNDRYMEN'S ASSOCIATION.

Dr. Richard Moldenke, Secretary, Watchung, N J.

PITTSBURG FOUNDRYMEN'S ASSOCIATION.

F. H. Zimmers, Secretary, care Union Foundry and Machine Co., West Carson Street.

PACIFIC COAST FOUNDRYMEN'S ASSOCIATION.

J. D. Morris, Secretary and Treasurer, Seattle, Washington.

BUFFALO FOUNDRYMEN'S ASSOCIATION

John E. Gorss, Secretary, 23 Builders' Exchange

THE ASSOCIATED FOUNDRY FOREMEN.
Frank C. Everitt, care the J. L. Mott Iron Works, Trenton, N. J., Secretary.

CLEVELAND FOUNDRY FOREMEN.
H. M. Lane, 610 Schofield Bldg., Secretary.

CINCINNATI FOUNDRY FOREMEN
E. W. Cadwell, Secretary, care S. C. Tatum Co.

MILWAUKEE FOUNDRY FOREMEN'S ASSOCIATION.
Julius Germanson, 931 Allis Street, Milwaukee, Wis., Secretary.

SOME METHODS OF MEASURING HIGH TEMPERATURES.*

By T. Swinden, Mappin Medalist, Sheffield University, 1851 Royal Exhibition Research Scholar.

The paper was opened by a brief outline of the necessity for this branch of work amongst iron and steel makers and users. The author then gave in some detail the principles underlying the various branches of pyrometry, with a view to pointing out the liability to error in using the different instruments. *Resistance pyrometers,* with their equipments, and some applications were first dealt with. Then followed the *Thermo electric instruments* of Le Chatelier, with all the modern modifications for up-to-date work, by Paul, Bristol and others. *Radiation and optical* methods were then outlined, and the Fery, and Wanner instruments fully described. A number of applications of the latter to foundry work, taken by the author, were given. The following table shows one of these, representing some cupola practice.

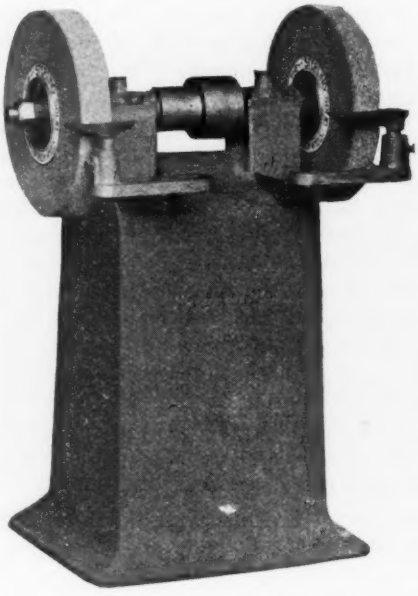
Time.	Approximate weight tapped.	Tapping Temp. deg. C.	Casting Temp. deg. C.
4:10 p. m.	6 Cwts.	1280	1240
4:33	11 "	1350	1240
4:40	4 "	1316	1274
4:55	5 "	1325	1255
5:00	5 "	1355	1250

Siemen's water pyrometer was briefly described, and was followed by *Uehling's pneumatic* instrument. Of this, details were fully given, together with some examples of its application to hot blast work. The *Seger cones, thermophone, fusible pills,* etc., were also included for the sake of completeness.

*Abstract of a paper read before the British Foundrymen's Association.

The conclusion of the paper took the form of a summary of the points of suitability or otherwise of the various instruments for foundry work.

The rather expensive and fragile resistance pyrometers, although of undoubted accuracy, are hardly suitable for foundry work. The *Thermo electric* instruments come nearer in point of application; the portability, cheapness and reliability of the instruments being greatly in their favor. The *optical*



A New Grinding Stand.

instruments, while possessing both unique advantages and disadvantages, are greatly in advance of either of the foregoing, since their application is so easy in cases where even thermo couples would be useless. The Fery instrument is a splendid example of this class.

The *Uehling* is, of course, *the* instrument for blast man and hot gas recording. The durability and sensitiveness of both the instrument and recorder are unquestioned, the cost being the only objectionable point. The *water pyrometer* is extremely good for intermittent readings where applicable, but their field of usefulness

is rather limited. This applies also to the Seger cones, etc., mentioned.

Finally, the fact that each instrument is only suitable for the especial work for which it is designed, if full benefits are to be derived, was reiterated.

A NEW GRINDING STAND.

Designers of grinding stands are beginning to realize the value of heavy rigid construction, and the box pedestal is replacing the old light frame which is better to run it in this manner. The size illustrated has a 1¼ inch spindle between flanges, the flanges being 5½ inches in diameter, the spindle itself being 1⅜ in the bearings. The rests are made adjustable and provision is made for a change in the speed as the stones wear down by fitting the pulleys on the driving shaft.

A FOUNDRY SAND MIXER.

Every year sees more labor-saving appliances introduced into all branches

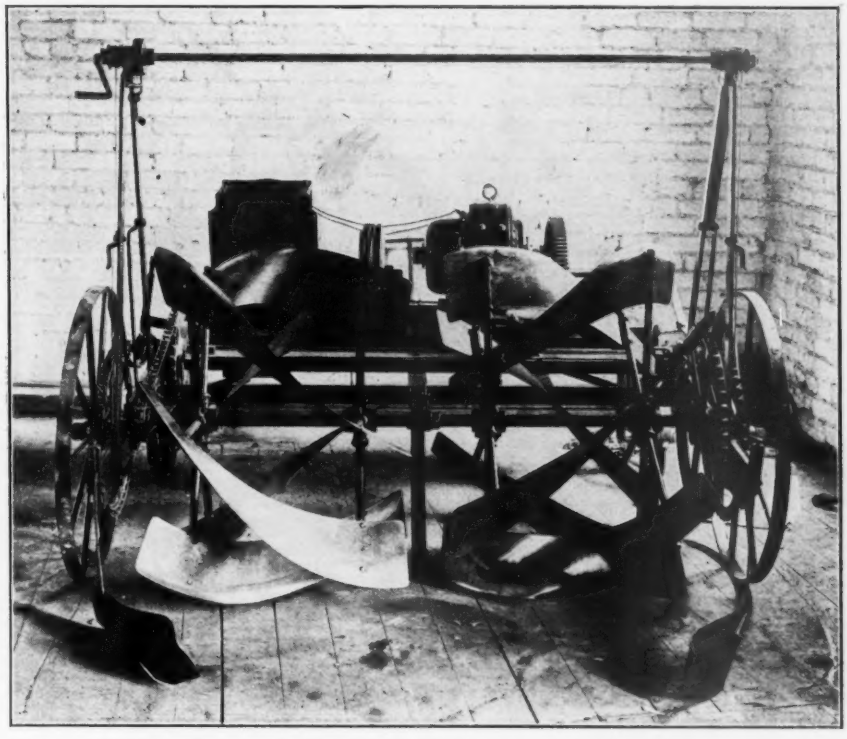


FIG. 1.—STOCKHAM SAND MIXER, KNIVES DOWN AND READY FOR USE.

was in evidence on the earlier types of machines. A good example of this is shown in the accompanying illustration. It is taken from a machine recently brought out by the Sterling Emery Wheel Mfg. Co., of Tiffin, Ohio. The bearings are long and are provided with self-oiling boxes. The shaft is rigid and no longer than is absolutely necessary for the bearings and the driving pulley. Arrangements can be made to belt the machine from below when it of work, but up to the present time the sand heaps in the foundry have always been cut over by hand. Foundrymen have realized that this was a slow and costly method, but the general foundry conditions have thus far prevented the introduction of machinery for this purpose. At last, however, an inventor has turned his attention to this subject and solved the problem, the result being the Stockham mixer shown in the accompanying illustrations and

manufactured by the Stockham Homogeneous Mixer Mfg. Co., of Piqua, O.

This machine is patented in both the United States and foreign countries and is now ready for the market. It is self-propelling and may be driven by electricity or any other suitable motive power. When in operation the large or driving wheels advance the machine at such a rate that the rapidly rotating knives pass through the sand heap at intervals of one-half inch. The knives cut down through the heap and then throw the sand to the rear. The curved form of the knife blades is such that the sand is thrown up in a ridge behind the machine, just as it would be in the old mixing process and the fact that each knife cuts from the top to the bottom of the pile and then distributes this amount of sand evenly over the pile results in very thorough mixing. It also makes it possible to introduce new molding sand, facing material, or anything of the kind, by simply distributing it evenly over the top of the pile before the machine is sent through it. The machine is followed by a pair of scrapers which serve to trim up the bottom of the pile and leave it neat. The parts are made strong enough so that nails or gaggers in the sand will not injure the machine, while an automatic cut-out is arranged which instantly stops the machine if the blades strike any hard substance offering resistance, such as a clamp, gate or casting. It is claimed that under favorable conditions one of these machines can cut up 100 heaps of sand, each 60 feet long, in ten hours. The machine complete weighs 650 pounds and can be operated with either direct or alternating current at any standard voltage. The machine can also be used for cutting up core sand by spreading the various ingredients one on top of the other

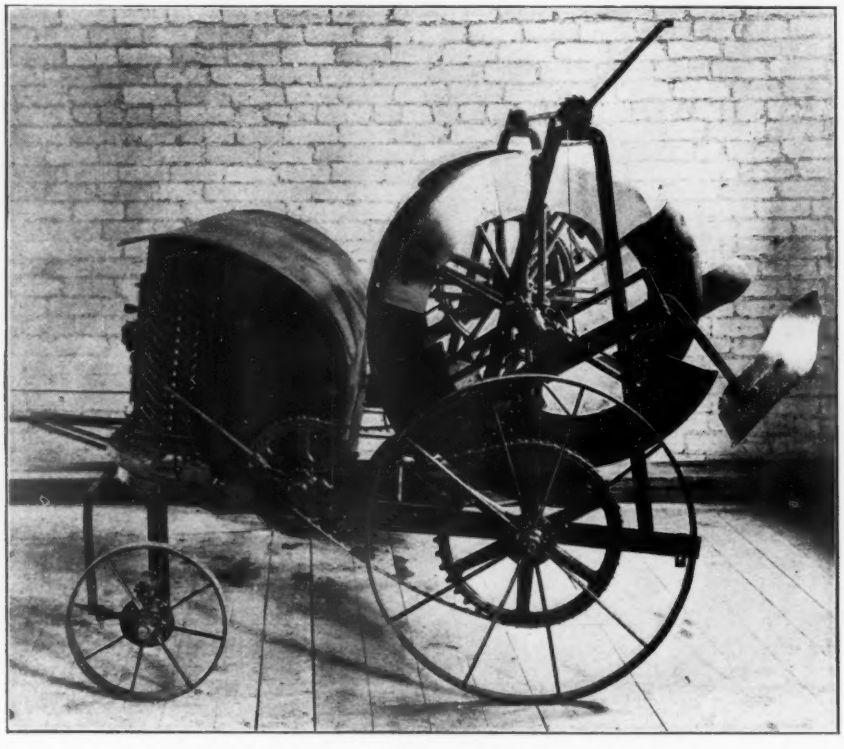


FIG. 2.—STOCKHAM SAND MIXER, KNIVES RAISED FOR TRANSPORTATION ABOUT THE SHOP.

in a heap and then sending the machine along the heap. The mixing will be very much more thorough than that accomplished by hand shoveling. It is said that a machine of this kind can mix core sand or facing sand at the rate of ten tons per hour. When not in use, or when being moved from one place to another, the revolving blades are swung up clear of the floor, as shown in one of the illustrations.

PERSONALS.

William Lodge, of the Lodge & Shipley Machine Tool Co., is acting as general manager of the Steel Foundry Co., Cincinnati, filling the vacancy caused by the retirement of C. G. Robinson. George Hart, of Columbus, has been appointed foundry foreman. Stockholders of the company have voted to increase the capital stock $20,000.

James C. Loughry, of Elyria, O., whose article on cost finding read before the American Foundrymen's Association at Indianapolis two years ago will be remembered by many foundrymen, is now devoting his entire time to installing proper cost systems in manufacturing plants.

L. W. Lukens, who for the past fourteen years has been superintendent of the Illinois Malleable Iron Foundry of Chicago, has been appointed superintendent of the Keystone Foundry plant of the International Harvester Co., at Rock Falls, Ill.

Frederick Crabtree, professor of mining and metallurgy in Colorado College, has been made assistant professor of metallurgy in the Carnegie Technical Schools. He is a native of England, was educated at the Massachusetts Institute of Technology, and has held a number of positions with various steel companies, being for a time chief chemist of the National Tube Co., and of the Colorado Fuel & Iron Co.

J. G. Coleman, for many years secretary of the Wisconsin Malleable Iron Co., Milwaukee, Wis., has retired and has been succeeded by W. P. Westenberg, who has been connected with that company for twenty years or more, the greater part of the time as superintendent.

S. T. Wellman, president of the Wellman-Seaver-Morgan Co., Cleveland, who has been in Japan for the last three months, accompanied by his wife, son and daughter, sailed from that country Aug. 4, arriving safely in San Francisco on Aug. 21.

Chas. A. Price, former supply agent of the Detroit district of the American Car & Foundry Co., has been promoted to district managership with headquarters at Memphis, Tenn. He is succeeded by John H. Hanna, who has been his assistant for some time. George L. Henrion, who has been in charge of the Memphis plant since its purchase two years ago, will take the superintendency of the plant at Madison, Wis.

R. A. Cole has resigned his position as traveling salesman with the Haydenville Co., Haydenville, Mass., to accept a position as secretary and traveling salesman for the lately incorporated Bay State Brass Co., Haydenville, Mass., manufacturer of plumbers' goods.

E. H. Putnam has been made foreman of the foundry of the Moline Elevator Co., Moline, Ill.

Archibald McAdam, for the last five years employed in the capacity of local auditor of the American Car & Foundry Co., will succeed W. C. McMahon as manager of the sales department of the Michigan Malleable Iron Co. W. C. McMahon will hereafter devote his time to the management of the Monarch Steel Casting Co.

DEATHS.

Paul Dickinson, president of the Paul Dickinson Iron & Locomotive Works, Chicago, died Sept. 1 at his residence in Winnetka, having been ill for over a year. Mr. Dickinson was formerly a partner in the firm of Turner & Dickinson, but some years ago bought out his partners and established a foundry at 188 West Madison street under his own name.

Griffith T. Jones, general manager of the Nashville Foundry Co., died on Sept. 10 at Nashville, Tenn. Mr. Griffith was formerly secretary and treasurer of the Nashville Stove & Foundry Co., and also secretary of the old

Phoenix Mfg. Co. For some time he was the senior member of the firm of S. E. Jones' Sons, which later became the Nashville Foundry Co.

FIRES.

Fire destroyed the main building of the Worcester Steel Foundry Co.'s plant at Millbury, Mass., on Sept. 14, resulting in a loss of $25,000.

The brass foundry owned by William P. Clark, Medford, Mass., was burned on Aug. 18, resulting in a loss of $8,500.

The office and pattern shop of the Taylor Engineering & Construction Co., of South Allentown, Pa., were totally destroyed by fire on Sept. 9, resulting in a loss of $60,000, partly covered by insurance.

The foundry and machine shops of the D. June Co., Waco, Tex., was destroyed by fire Aug. 26, with a loss of $10,000.

The Dakota Machinery Co., Devil's Lake, N. D., sustained a loss of $10,000 by fire Aug. 20.

The Boundary Iron Works, Grand Forks, B. C., was damaged to the extent of $30,000 by a recent fire.

The Fulton Iron Works at Harbor View, near San Francisco, Cal., sustained a heavy loss by fire on Aug. 31. The foundry was completely destroyed.

The foundry building of the Stow Flexible Shaft Co., Binghamton, N. Y., suffered an estimated damage by fire of $2,000 on Aug. 30.

The plant of the Phoenix Foundry Co., 586-600 Jefferson street, Chicago, was destroyed by fire Sept. 6, the loss being about $10,000.

NEW CONSTRUCTION.

John J. Kennedy, Lewiston, Me., is to erect a small foundry.

The foundry of the new Bay State Brass Co., Haydenville, Mass., is now in operation.

The General Electric Co. is said to be contemplating the erection of an extensive foundry plant at West Lynn, Mass. A manufacturing plant is now under construction there, the main building being 80 x 520 feet.

L. G. McKnight & Son are building a new foundry in Gardner, Mass., and will be glad to receive catalogs of foundry equipment.

The Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., is to erect a small structure connecting its two present buildings.

J. E. Plimpton, Norwood, Mass., is building an addition to his foundry, 26 x 90 feet, to be used as a molding room and machine shop.

The factory to be erected at New Haven, Conn., by F. P. Pflegher & Sons, manufacturers of hardware and special machinery, will consist of a four-story reinforced concrete structure 60 x 260 feet, with a one-story building 40 x 200 feet, to be used as a casting room, forge shop, annealing room and engine room.

The Woburn Machine Co., Woburn, Mass., has begun work on an iron foundry 58 x 90 feet and a carpenter and pattern shop 30 x 60 feet

The Potter & Johnson Machine Co., Pawtucket, R. I., has let the contract for a one-story brick building, 46 x 147 feet, to be used as a casting cleaning department.

The Goodell-Pratt Co., Greenfield, Mass., is to enlarge its works by the erection of a new foundry 75 x 170 feet, two stories in height.

The Fillmore Avenue Foundry & Iron Works, of Buffalo, N. Y., is building an addition to its pattern shop and will employ about fifteen additional patternmakers. The company is also said to be planning the erection of a large foundry which will increase its output by from 50 to 75 tons daily, definite specifications for which will be made public later.

The W. P. Taylor Co., successor of Bingham & Taylor, Buffalo, is erecting a new foundry building.

The Buffalo Forge Co., Buffalo, N. Y., has begun operations in its new plant, employing about 70 men in its foundry, and will later employ at least 120. It is a modern foundry, of gallery construction, which increases the total floor space fully 50 per cent, and is equipped with an electric traveling crane and an industrial railway for handling heavy work.

The Malleable Iron Co., Troy, N. Y., has awarded contract for an addition to its present core room, 50 x 200 feet, the third important addition to the plant within a year.

The Weatherly Foundry & Machine Co., Weatherly, Pa., is building an addition, 70 x 150 feet, of brick and iron.

The Federal Steel Casting Co. is building a new open-hearth furnace at its Chester, Pa., plant. Other improvements, including annealing plants, are under way.

The Cascade Foundry Co., Erie, Pa., of which John D. Hay is president, has purchased a site on which it will erect a $50,000 foundry building.

The Globe Foundry Co., Johnstown, Pa., which has purchased the foundry of W. F. Rosensteel, expects to enlarge the plant and make a specialty of car castings.

The William Osborne Machine & Foundry Co., DuBois, Pa., is to erect important additions to its plant.

The new foundry which the American Seeding Machine Co., Springfield, O., is to build as an addition to its Superior plant, will be double the capacity of the old one, and will have a floor space of 30,000 square feet.

The Red King Mfg. Co., Wauseon, O., has just completed a new foundry. This company was reorganized a year ago and the capital increased to $50,000, and a foundry was built at that time, but its increasing business has made an additional building necessary.

The Lamner Mfg. Co. will erect a foundry at Brookside Park, Cleveland, at a cost of $20,000.

Plans for the new plant of the Cincinnati Milling Machine Co., to be erected on the Factory Colony property at Oakley, near Cincinnati, include a two-story administration building, 62 x 120 feet, a foundry building, 62 x 280 feet, a building for cleaning castings and storing, 62 x 530 feet, a charging building, 62 x 128 feet, and a pattern shop, 62 x 180 feet, all of brick and steel construction.

The new plant of the City Brass Foundry Co., Cleveland, is now in operation. Its equipment is of the most modern type, including twelve furnaces and core ovens. Custom work, including all classes of brass, aluminum, manganese and bronze castings, will be done, recent improvements having quadrupled the output of the company.

The Cleveland Gas & Electric Fixture Co. will soon move into its new plant at Conneaut, O. It is now using the plant formerly occupied by the Record Mfg. Co., and the building which was used for making tin plate has been equipped for a brass foundry.

The National Malleable Casting Co., Cleveland, has a storage building about 200 feet square well under construction.

The Vulcan Foundry Co., Cincinnati, O., will build a one-story brick foundry on Western avenue at a cost of $7,000.

A. W. Wagner, of Chicago, is the president of the new malleable iron company which is soon to begin the construction of its plant at Terre Haute, Ind. There will be two buildings of brick and steel, one 80 x 200 feet and the other 80 x 150 feet, and the company expects to have the plant in operation early in November.

Final plans have been completed for the extensive shops, foundries, etc., which the Big Four Railroad is to build at Beachwood Grove, near Indianapolis. Their total cost will be $5,000,000 and three years will be required to complete the work. The machine and erecting shop will be 312 x 572 feet.

The Lavigne Mfg. Co., Detroit, Mich., has secured a site of two acres on Commonwealth avenue and will erect a large factory and foundry plant for the manufacture of brass novelties.

The Wisconsin Foundry Co., Milwaukee, Wis., has prepared plans for a two-story reinforced concrete sturcture, 80 x 98 feet.

Work on the new Hill foundry, Kalamazoo, Mich., will soon be commenced.

The Ortonville Foundry, Ortonville, Minn., is adding new equipment to its plant to take care of its increasing business.

The Beggs Pipe & Foundry Co., Birmingham, Ala., has erected a building, 150 x 175 feet, in North Birmingham, and expects to start making soil pipe and fittings early in October.

The Southside Foundry & Machine works, Charleston, W. Va., has prepared plans for a brick foundry structure, 80 x 175 feet, of fireproof construction.

The new plant of the Richmond Foundry & Mfg. Co., Richmond, Va., consists of two buildings, each 80 x 350 feet, of iron and brick construction. 200 men will be employed in the manufacture of small iron castings and cast iron stoves, and it is expected that the plant will be in working order by October 1

The newly incorporated Southland Corporation, of Birmingham, Ala., which has taken over the plant and business of the Bartlett-Tewksbury Machinery Co., will erect several large foundry and machine shop buildings for which considerable equipment will be needed. The company will manufacture engines and sugar mills and do a general foundry and machine shop business.

The Southern Steel Works, Chattanooga, Tenn., which recently increased its capitalization, is to erect an additional building, 90 x 120 feet.

The Byron Jackson Machine Works, which has been temporarily located at Oakland, Cal., since the fire, has let the contract for a steel structure, 110 x 250 feet, with a large pattern shop, at West Berkeley, Cal.

The Central Foundry Co., Joplin, Mo., is contemplating the enlargement of its plant to accommodate its increasing business.

Perry Muggenstrom & Springer, of Spokane, Wash., are to erect and operate a foundry at Sandpoint, Idaho.

The Anti-Friction Spiral Bearing Mfg. Co., Hannibal, Mo., is erecting a foundry building and a number of other factory structures.

The Seattle Brass Co., Seattle, Wash., has purchased a site for the erection of a new plant, which it hopes to occupy by Jan. 1.

J. G. House and T. C. Link, of El Paso, Tex., have organized a new company for the purpose of manufacturing brass work of all kinds and doing general foundry and machine work, and as soon as a suitable location can be found in El Paso a new plant will be erected.

The American Car & Foundry Co., St. Louis, Mo., has taken out a permit for the erection of a steel foundry building to cost $110,000.

The Tower Grove Foundry Co., St. Louis, Mo., is erecting a one-story brick foundry to cost $1,500.

An addition, 22 x 60 feet, is being erected for the Brown Foundry, Newton, Ia.

A three-story factory building, 50 x 200 feet, a foundry structure, 64 x 150 feet, an engine and boiler house are to be built at Cote St. Paul, Que., in the Montreal district, by Jenkins Bros., of Bridgeport, Conn.

BRITISH FOUNDRY NOTES.

General satisfaction is expressed with the recent convention of British Foundrymen, at Middlesborough. One feature of the attendance was its representative character, members traveling from as far away as Portsmouth and Southampton, to be present. On the other hand, distant foundry centers in Scotland were well represented. This in itself is a good criterion of the popularity of the association; as the expense incurred would, in some cases, reach as much as £10. Apart from the conference itself, every opportunity was taken by the members to exchange notes with regard to details and difficulties of their calling; and the general conclusion suggested is that the demand for scientific founding in Great Britain is rapidly extending. The membership is also steadily increasing. The success of the conference is largely due to the excellence of the arrangements made by Mr. Finch, the secretary, who had apparently anticipated all the requirements of the convention, so that everything worked with the greatest smoothness. The opportunity was also taken to visit some of the largest smelting and foundry establishments in the kingdom, which are situated in this district.

At the Birmingham center, the members are now looking forward to the coming season, which is to commence on the third Saturday in October, with a meeting at the technical school. Three papers are already promised, including one each from Mr. Pilkington, the presi-

dent, and Mr. Percy Longmuir, a recognized authority on founding. An important part of the program will be a round of visits to important centers in Birmingham and district. It is hoped members will be able to pay a visit to the Birmingham Electric Generating Station, as well as to the Mond Power Plant, Tipton, and possibly to Sir Alfred Hickman's works. In this way, the members will be kept in touch not only with the theory, but with the practice of foundry engineering. The membership of this branch is steadily increasing, and some half dozen members have joined since the conference. The Birmingham center promises to be worthy of a great engineering neighborhood.

One of the results of the conference at Middlesborough is to be the formation of a center there. The president of the association, Mr. Pilkington, is taking considerable interest in this, and there is every hope of a strong branch being formed.

The great revival in trade has so far been kept clear of serious labor troubles; but a new movement for higher wages has now commenced which promises to touch all branches of the foundry and engineering trades. A conference of employers and workmen representing the General Federation of Engineers' Employers, and the Amalgamated Society of Engineers, has been held in London to consider an application for an advance of 2s a week in wages. The workers in Halifax have taken the lead, but Manchester, which is the second largest district in the kingdom, has already followed suit, and the Boiler Makers' Society, numbering 10,000 members have put forward a demand for a 5 per cent increase in wages, threatening a strike on September 15 if the advance is not conceded. The employers offered to confer with the men, but the offer was refused, the men preferring to take action by way of an ultimatum. The Manchester difficulty has been settled by the concession of an immediate 1s per week and a further 1s in January. The employers argued that their men had not been reduced even during the time of depression, and that therefore they should not be too pressing in their demands for a rise. Some months ago, the patternmakers started a movement for higher wages, but decided to postpone it, and there is every probability of their joining in the demand put forward by the engineers. The same subject has been considered by the molders, who are holding meetings; and no doubt is entertained that formal demands in the same direction will shortly be put forward. In the present state of trade, it is not likely that any serious resistance will be offered, so long as the demands are moderate. Latterly molders have become very scarce, and as a rule they can command their own price. As to the quality of the men, the employers are finding on the whole that the operatives are moving with the times, and, generally speaking, the men are better trained than they used to be. It is quite likely in the future that they will be able to command still higher remuneration.

In view of the attention lately directed to the introduction of turret lathes in the brass trade, it is worthy of note that such ladles have been in use for engineering purposes for a number of years, having been found of the greatest value. In most shops such details as studs, pins, and other small work of this kind are made from bars of rolled bright steel. The advantage of the system has been proved in many ways. On the whole the system is less expensive, while the improvement in quality and accuracy is very marked. The system will probably extend in future.

The rapid extension of the motor industry may be said to have added a new department to Birmingham foundry work, and some of the firms have taken up the business with great success. One firm, Messrs. Astbury & Son, of Smethwick, are taking a strong lead in the matter, and are winning a world-wide reputation for their motor cylinders. The firm formerly devoted themselves to the making of shells for war purposes. In these "piping times of peace" war material is rather at a discount, and the firm naturally had to look around for a substitute. The search has been eminent-

ly successful, and the firm has made a virtue of necessity to very good purpose indeed. They are extremely busy, and their plant will probably have to be extended before long to enable them to cope with the great demand.

The great rise in the price of raw material is being felt by the foundries, and certain establishments who failed to take advantage of the low prices prevailing a couple of months ago are not only having to pay fancy prices, but in some cases have the greatest difficulty in getting supplies. People who bought heavily will derive an enormous advantage during the next few months. In this respect, the position of companies differs very much, and some of the largest firms, who buy heavily, receive distinct preferential treatment from blast furnaces, whose owners are anxious to retain their custom. The probable demand for material must put the smelters in a very strong position.

Among the signs that British foundry work is progressing is the rapid extension of the system of casting from the blast furnace. It is becoming now quite the fashion to pour the metal into a mixer, and thence direct into the molds, without reheating the pig. The system has revolutionized the cast iron pipe industry, and has brought one or two old-fashioned firms to grief. The important firm of Messrs. Cochrane at Middlesborough have at the present time plans under consideration for extending very largely in this direction.

GENERAL INDUSTRIAL NOTES.

The Goldschmidt Thermit Co. is about to vacate its present manufacturing premises at 179 Christopher street, New York city, as they are insufficient for its largely increased business. The company has purchased ground at the corner of Cornelison and Bishop streets, in Jersey City, and has erected there a large and commodious factory building, 75 x 165 feet, within easy reach of its down-town offices, and will remove the manufacturing plant to its new location about Oct. 1.

The property of the Enterprise Foundry Co., Bristol, Tenn., was sold on August 6 to the Bristol Foundry & Machine Works of the same city, for the sum of $6,600. Maj. A. D. Reynolds is the principal stockholder of the purchasing company. The plant will be operated under its old name.

The Shenandoah Machine & Plumbing Co., Shenandoah, Va., which has been operating a machine shop, has added a foundry to its plant.

The Tennessee Foundry & Machine Co., Hamilton county, Tenn. has been incorporated with $20,000 capital, by J. G. Simpson, M. H. Coffee, F. S. Mead, Chas. Seymour and N. B. Morrell.

The business of the Crescent Furnace & Foundry Co., Des Moines, Ia., has been purchased by Jesse R. A. Griffith, John N. D. Griffith and A Griffith.

The foundry department of the Hyrum A. Silver Foundry & Machine Co., Salt Lake City, Utah, recently made its first cast. The plant is a model one and will employ about 100 men.

The Lloyd Metal Co., Houston, Tex., has been organized with a capital of $10,000 to manufacture and sell castings of iron and steel. The incorporators are W. H. Lloyd, W. H. Norris and Joe H. Eagle.

It is reported that the Iowa Pump & Mfg. Co., Ft. Dodge, Ia., will take over the foundry of Fackler & McMullan, on which it has held an option for some time, and do its own casting in future.

The Neches Iron Works, Beaumont, Texas, has increased its capital stock from $50,000 to $100,000.

The plant of the Waterman Wheel & Foundry Co., Houston, Tex., is ready for operation. The plant is a model one and its capacity will be heavy. J. J. Settegast Jr., is president of the company, and A. J. Binz, secretary and treasurer.

The Business Men's League, of St. Joseph, Mo., has prepared a handsome folder setting forth the commercial ad-

vantages of that city. Horace G. Krake, commissioner, writes that there are excellent openings for additional manufacturing plants for iron articles, such as house appliances and farm and mining machinery, and states that a malleable iron casting plant is also badly needed. Local capital can be interested in meritorious enterprises, it is stated, if established and operated by men of experience and reliability.

The Riverside Foundry & Machine Works, Riverside, Cal., has lately elected the following directors: George Frost, Stanley J. Castleman, T. D. Hewitt, J. A. Simms, and H. B. Henderson. George Frost is now president and H. B. Henderson, who has been secretary, is manager.

The Down Draft Base Burner Stove Co., of Guthrie, Okla., has been incorporated with a capital stock of $50,000. The incorporators are William J. Mundy, of Petrolia, Ont., and G. V. Pattison and H. W. Pentecost, of Guthrie.

The Prier Brass Mfg. Co., of Kansas City, Mo., has been incorporated with a capital of $40,000. The incorporators are Adolph A. Prier, Walter H. Prier, and Ernest Durst.

The Citizens of Port Hope, Ont., have voted to grant exemption from taxes for ten years to the branch of the Central Foundry Co., which is to be located there.

The plant of the Ottawa Furnace & Foundry Co., Ottawa, Ont., has been purchased by S. J. Travers, of Montreal, and George Tomlinson, G. A. Mothersill, and J. I. MacCraken, of Ottawa. The plant closed about six months ago, but the new owners expect to have it operating within a month.

The Lancaster Mfg. Co., Lancaster, Pa., has been incorporated under New Jersey laws to manufacture electric car track brakes, car track shoes and electric appliances and to carry on the business of machinists and founders. The capital stock is $125,000 and the incorporators are A. H. Powden and J. K. Gibbie, Lancaster, Pa., and J. B. R. Smith, Trenton, N. J.

Pettinos Bros., of Bethlehem, Pa., dealers in foundry supplies, have moved their Philadelphia office from 16th and Callowhill streets to 313-317 North 15th street.

The Alliance Foundry Co., recently organized at Alliance, O., with a capital of $20,000, has elected W. H. Kelley president and general manager; J. M. Kelley, of Alliance, vice-president and assistant manager, and W. F. Doyle, secretary and treasurer. The foundry department of the Aultman works at Canton, O., has been leased and will be put in operation with 40 molders.

The Petersburg Fire Brick & Tile Co., Coal Grove, O., reports a heavy sale of its cupola daubing or fix, which is made of ganister and fire clay. The foundries mix it into a stiff mud and plaster up the iron bed to the tuyeres and over the bottom of the cupola, finding that it stands the heat and blast, and if used regularly preserves the cupola lining for years. It is also used for core making and for general foundry use.

The Miami Brass Foundry Co., of Dayton, O., has been incorporated with a capital of $10,000 by Benjamin Semelman, Herman A. Stien, Joseph Medman, Abe Semelman and Sol. Flatau.

The American Roll & Foundry Co., Canton, O., has been incorporated with a capital of $200,000. The incorporators are James B. Baird, William Gardner, Edward Langenbach, Austin Lynch and David B. Day.

The Peck-Williamson Co., Cincinnati, manufacturing furnaces, is seeking a new site on which to combine its foundry and factory. The foundry plant at present located at Wellston, O., will probably be removed to Cincinnati.

The Favorite Stove & Range Co., Piqua, O., has increased its capital stock from $300,000 to $1,500,000.

The West Steel & Iron Casting Co., Cleveland, O., recently organized with a capital of $30,000, has elected Ralph H. West president and treasurer, Frederick Baird, vice-president, and David P. Landsdowne, secretary. The company will manufacture a high grade of steel castings by the converter process, ranging from one pound to five tons in

weight. Ground has been broken at E. 70th street and the L. S. & M. S. R. R. and it is expected that the plant will be ready for operation by December 1.

The Indiana Foundry & Machine Co., South Bend, Ind., has purchased of Joseph Bergan and William B. Starr the real estate on which the company's plant is located for the sum of $2,500.

The foundry and machine shop of the Bridge City Construction Co., Logansport, Ind., after a month's idleness, have resumed operations under the management of A. C. Ross & Co., of that city.

The Langsenkamp-Wheeler Brass Works, Indianapolis, Ind., has been incorporated to manufacture brass goods, machinery, patterns, etc. The capital stock is $120,000, and the incorporators are Frank H. Wheeler, Henry Langsenkamp and Wm. Langsenkamp Jr.

The Love Brake Shoe Co., Chicago, has been incorporated with a capital stock of $100,000. C. W. Armbrust is president of the company, William George, secretary, and Joy Love, treasurer. The company will not acquire any additional buildings, as it already controls three foundries at Aurora, Ill., with a capacity of 100 tons daily, but will sell the Armbrust brake shoes to railroads direct and license railroads and foundries in various parts of the country.

The J. S. Armstrong Machine & Foundry Co., Peoria, Ill., has been organized with a capital of $40,000 by J. C. Armstrong, C. A. Armstrong and E. Banvard.

The Kankakee Foundry Co., Kankakee, Ill., has been incorporated with a capital of $75,000 by Thomas G., M. F. and P. V. Gartland. The new company will take over the business which has been operated as the Gartland foundry.

The Belleville Foundry Co., Belleville, Ill., has been organized to do a general line of casting and jobbing business. R. W. Robriquet is president and I. H. Wangelin is secretary and treasurer.

Pettigrew Bros., of Joliet, Ill., have purchased the equipment of the Higgins machine shop and foundry at Braidwood, Ill., and will move it to Joliet.

The plant of the Bloomington Stove Co., Bloomington, Ill., has been sold to W. G. Bayce & Son for $10,100.

The Ideal Foundry Co., Grand Rapids, Mich., has been organized with a capitalization of $10,000 by Charles H. Glaser, Theodore H. Weiland, James Vidro and John Tennis. The company has its new plant, at West Division street and Valley avenue, nearly completed.

Edward Glazier has opened the Bad Axe foundry, at Bad Axe, Mich., and will operate it for custom work.

The machinery and foundry equipment of the Allegan Foundry & Machine Co., Allegan, Mich., has been removed to its new building.

The Nortmann-Duffke Foundry Co., Milwaukee, Wis., has lately filed an amendment increasing its capital stock from $20,000 to $50,000.

The Standard Cast Iron Pipe Foundry Co., of Camden, N. J., has been incorporated with a capital of $2,000,000. The incorporators are Joseph D. Kean Jr., George W. Bunting and H. Bayard Hodge, all of Camden.

The Stanford Steel Range Co., Sheffield, Ala., has been incorporated with a capital of $20,000 to manufacture stoves, furnaces and ranges. William R. K. Stanford is president, C. T. Robinson, vice president, and E. B. Wright, secretary and treasurer. A steel foundry will be operated.

The Atlanta Plow Co., Atlanta, Ga., has been organized with a capital stock of $50,000, by J. W. Hightower, J. B. Hightower, G. W. Brown and S. J. Brantley.

The Southern Farm Tool Co., Atlanta, Ga., has been incorporated with a capitalization of $10,000 and privilege of increasing to $50,000. The incorporators are W. J. Stapler, John P. Keeden and T. H. Williams.

Controlling interest in the South Atlantic Car & Mfg. Co., Savannah and Waycross, Ga., has been purchased by Frank H. Durden, F. M. Durden and W. N. Durden. The capacity of both plants will be largely increased.

The Chicago Pneumatic Tool Co. has opened an office in the Memphis Trust building, Room 1012, Memphis, Tenn.,

and placed Mr. J. Francis Small in charge. The southern business will be handled through the Memphis office.

All have been familiar for a long time with the boards of trade and other similar organizations situated in large cities for the purpose of inducing manufacturers to locate in advantageous positions. The industrial department of the Rock Island-Frisco lines has now established an office in St. Louis, Mo., with M. Schulter in charge as industrial commissioner, the object of which is to induce manufacturers to locate along the lines controlled by the interests represented. This new department will furnish information concerning the facilities for procuring raw materials for any industry, concessions which would be granted by local authorities in the way of land, exemption from taxes, etc., and any other information which would enable business men to investigate the situation at any point along the lines controlled by these interests, which traverse seventeen states and territories.

The Standard Brass Mfg. Co., of St. Louis, Mo., has increased its capital stock from $3,000 to $10,000.

The Liberty Foundry Co., St. Louis, Mo., has been incorporated with a capital stock of $6,000 by C. Edward Walters, Charles H. O'Laughlin, Frank Vanek and others. The company will at once erect a foundry plant.

The Florence Iron Works, of Florence, Colo., is to be incorporated with a new charter and will then take up the manufacture of gas, gasoline and alcohol engines.

The Killing Molding Machine Co., Davenport, Ia., has been organized by the purchasers of the MacPhail molding machine plant to take over the business of the old company.

The Acme Malleable Iron & Foundry Co., Tacoma, Wash., has been incorporated with a capital of $25,000 by T. H. Bellingham, J. W. Bechtel, B. S. Weed, Theodore Shenkenberg and Ben Haverkamp.

A. L. Taylor, Oakland, Cal., successor to Fair, Taylor & Co., reports that the work of the late S. R. Church on "Analysis of Pig Iron" can no longer be had, as the remainder of the edition was destroyed in the San Francisco fire.

The Torreon Iron Works, Torreon, Mex., was lately reorganized and the following officers elected: E. H. Barton, president; Emilio P. Stein, treasurer; and J. Newman, secretary. A general foundry business will be conducted.

The Hensall Foundry & Mfg. Co., Ltd., of Hensall, Ont., has been incorporated with a capital of $40,000, to manufacture and sell plumbing and heating supplies and to do a general foundry business.

TRADE PUBLICATIONS.

Warren Webster & Co., of Camden, N. J., are sending out a standard size, 6 x 9, catalog of 32 pages, describing their "Star-Vacuum" feed-water heater, purifier, filter and receiver. This is one of the best trade publications of the kind which we have seen in a long time, both as to reading material and illustrations. The illustrations are particularly clear, showing each stage of the operation and illustrating the apparatus in great detail.

The Rockwell Engineering Co., of New York City, is sending out a standard size catalog, 6 x 9, describing the Rockwell fuel oil burning appliances. Now that fuel oil is being used so extensively in metallurgical plants, it is becoming necessary to look after the economies of handling the oil, its combustion, etc., as closely as possible, and this catalog will be found to contain much information for all interested in the use of this class of fuel. One table which the catalog contains is an extremely useful one. It gives the capacity of oil tanks of various sizes for each inch of depth of oil when the tank is in a horizontal position.

The Curtis & Co. Mfg. Co., St. Louis, Mo., is sending out a standard size catalog, 6 x 9 inches, describing all of the lines of pneumatic appliances made by this company, which include compressors of various types, pneumatic hoists, both direct and indirect, pneumatic cranes, trolley systems, elevators and other special equipment for foundry work and other work about manufacturing plants.

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Norton Company, Worcester, Mass.

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Gunn, Richards & Co., New York.
Library Bureau, Systematizing Dept., Boston.

Air Compressors:
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Chicago Pneumatic Tool Co., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Ingersoll-Rand Co., New York.
Norwalk Iron Works Co., So. Norwalk, Conn.

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Phosphor Bronze Smelting Co., Ltd., Philadelphia.

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Analysis—Chemical:
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Babbitt Metal:
Ajax Metal Co., Birmingham, Ala.

Blowers:
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Connersville Blower Co., Connersville, Ind.
Cornell Co., J. B. & J. M., New York.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

Blowers—Positive Pressure:
Connersville Blower Co., Connersville, Ind.
Piqua Foundry & Mch. Co., Piqua, O.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

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Buildings (Struct. Steel):
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Monarch Engineering & Mfg. Co., Baltimore.

Carbonese:
Midvale Mining & Mfg. Co., E. St. Louis, Ill.

Castings (Steel):
Otis Steel Co., Ltd., Cleveland.

Cement (Furnace):
Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.

Cement (Metallic):
Clark Cast Steel Cement Co., Shelton, Conn.
Shelton Metallic Filler Co., Derby, Conn.
Shanafelt Mfg. Co., Canton, O.
Smooth-On Mfg. Co., Jersey City.

Chaplets:
Burdick & Son, Albany.
Fanner Mfg. Co., Cleveland.
Lindsay & Co., W. W., Philadelphia.
Shanafelt Mfg. Co., Canton, O.
U. S. Chaplet Co., New York.

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Millett Core Oven Co., Brightwood, Mass.
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Pangborn Co., Thos. W., New York.
Smith Foundry Supply Co., J. D., Cleveland.

Core Oven Recording Thermometer:
Bristol Co., Waterbury.

Cost Keeping Systems.
Gunn, Richards & Co., New York.
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Cranes:
Case Mfg. Co., Columbus, O.
Curtis & Co. Mfg. Co., St. Louis, Ill.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia.
Niles-Bement Pond Co., New York.
Northern Engrng. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Ridgway & Son, Craig, Coatesville, Pa.
Sellers & Co., William, Inc., Philadelphia.
Whiting Foundry & Equipment Co., Harvey, Ill.

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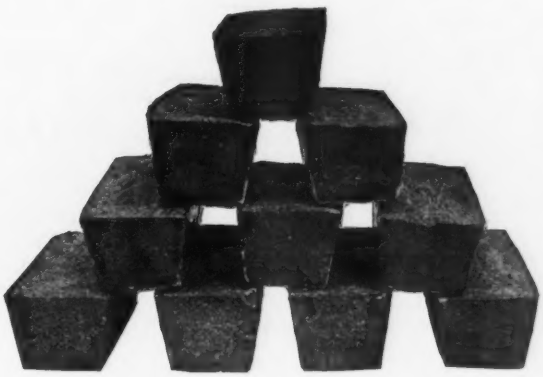

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Paxson Co., J. W., Philadelphia.
Ross-Tacony Crucible Co., Philadelphia.
Seidel, R. B., Inc., Philadelphia, Pa.
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McCormick Co., J. S., Pittsburg.
Northern Engnrng Works, Detroit.
Paxson Co., J. W., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

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Elevators:
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Engines (Gas):
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

Engines (Steam):
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Sturtevant Co., B. F., Boston.

Engineers (Foundry, Mech., Elec., &c.):
Dodge & Day, Philadelphia.
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Lindsay & Co., W. W., Philadelphia.

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Hill & Griffith Co., Cincinnati.
R. MacKellar's Sons Co., Peekskill, N. Y.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
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Smith Foundry Supply Co., J. D., Cleveland.
Stephens & Co., Kidwelly, Eng.
Stevens, F. B., Detroit.
Western Foundry Supply Co., E. St. Louis, Ill.

Fans:
American Blower Co., Detroit.

Ferro-Manganese:
Kendall & Flick, Washington, D. C.
Rogers, Brown & Co., Cincinnati.

Ferro-Silicon:
Roessler & Hasslacher Chemical Co., New York.
Rogers, Brown & Co., Cincinnati.

Fillers (Metallic):
Clark Cast Steel Cement Co., Shelton, Conn.
Shanafelt Mfg. Co., Canton, O.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Fillets:
Cleveland Fillet Co., Cleveland, O.
Shanafelt Mfg. Co., Canton, O.

Fire Brick:
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Maurer & Son, Henry, New York.
Paxson Co., J. W., Philadelphia.

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Barnett Fdy. Co., Oscar, Newark.
Brass Founders' Supply Co., Newark.

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Smith & Caffrey Co., Syracuse, N. Y.

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Piqua Flour Co., Piqua, O.

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Barnett Fdy. Co., Oscar, Newark.
Etting, Edward J., Philadelphia.
Obermayer Co., S., Cincinnati.
Pangborn Co., Thos. W., New York.
Sly, W. W. Mfg. Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.
Wiener Co., Ernest, New York.

Foundry Supplies:
Fair, Taylor & Co., San Francisco.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
Osborn Mfg. Co., Cleveland.
Pangborn Co., Thos. W., New York.
Paxson Co., J. W., Philadelphia.
Shanafelt Mfg. Co., Canton, O.
Smith Foundry Supply Co., J. D., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

Furnaces (Melting):
Barnett Foundry Co., Oscar, Newark, N. J.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Rockwell Engineering Co., New York.

Grinding Machinery:
Adams Co., Dubuque, Ia.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Norton Co., Worcester.
Ransom Mfg. Co., Oshkosh, Wis.

Grinding Wheels:
Norton Co., Worcester.
Pike Mfg. Co., Pike, N. H.

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The Cost of It

The expense of a modern system of cost-keeping need be no greater than a crude, antiquated and inefficient way of keeping accounts.

Such a system is accurate, quick and in ample detail, and it gives the detailed costs of every part of the work while the business is fresh—when it is most valuable as a basis of comparison.

We have studied cost-keeping very carefully and have installed systems which meet these requirements in many well-known foundries.

Will you accord us an interview?

GUNN, RICHARDS & COMPANY

Production Engineers and Public Accountants.....

43 WALL STREET, 43 EXCHANGE PLACE, NEW YORK

50 CONGRESS STREET, BOSTON

224 ST. JAMES STREET, MONTREAL

Hammers (Pneumatic Chipping):

Dayton Pneumatic Tool Co., Dayton, O.
Ingersoll-Rand Co., New York.

Heating & Ventilating Apparatus:

American Blower Co., Detroit.
Sturtevant Co., B. F., Boston.

Hoists:

Curtis & Co., Mfg. Co., St. Louis.
General Pneumatic Tool Co., Montour Falls, N. Y.
Harrington Son & Co., Edwin, Philadelphia.
Niles-Bement-Pond Co., New York.
Northern Engrg. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Sellers & Co., Inc., William, Philadelphia.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Hoists (Pneumatic):

Ridgway & Son, Craig, Coatesville, Pa.

Hydrofluoric Acid:

General Chemical Co., Philadelphia.

Industrial Ry. Equipment:

Atlas Car & Mfg. Co., Cleveland.
The Gregg Company, Ltd., Newburg, N. Y.
Wiener Co., Ernest, New York.

Iron Ore:

Rogers, Brown & Co., Cincinnati.

Lacquers:

New Era Lustre Co., New Haven.

Ladles:

Northern Engrg. Works, Detroit.

Molding Machines:

Adams Co., Dubuque, Ia.
Arcade Manufacturing Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Herman Pneumatic Machine Co., Zelienople, Pa.
McPhail Molding Machine Co., Davenport, Ia.
Manning, Maxwell & Moore, New York.
Maywood Foundry & Machine Co., New York.
Mumford Co., E. H., Philadelphia.
Paxson Co., J. W., Philadelphia.
Pridmore, Henry E., Chicago.
Tabor Mfg. Co., Philadelphia.
Turner Machine Co., Philadelphia.

Oil (Linseed):

Holland Linseed Oil Co., Chicago.

Pattern Letters:

Shanafelt Mfg. Co., Canton, O.

Packing (Rubber Sheet):

Smooth-On Mfg. Co., Jersey City.

Parting Materials:

Foundy Specialty Co., Cincinnati.
Partamol Co., New York.

Patterns (Metal & Wood):

Herman Pneumatic Machine Co., Zelienople, Pa.

Pattern Shop Equipment:

Fox Machine Co., Grand Rapids, Mich.

Phosphorizers:

McCullough-Dalzell Crucible Co., Pittsburg.

Phosphor Tin:

Crescent Phosphorized Metal Co., Philadelphia.
New Era Mfg. Co., Kalamazoo.

Pig Iron:

Addy & Co., Mathew, Cincinnati.
Baird & West, Detroit.
Bartlett & Co., N. S., Boston.
Cherry Valley Iron Co., Pittsburg.
Columbus Iron & Steel Co., Columbus.
Dalton, Nash & Co., New York.
De Camp Bros. & Yule, St. Louis.
Dimmick & Co., J. K., Buffalo.
Domhoff & Joyce Co., Cincinnati.
Elliott, Debevoise & Anderson, New York.
Field Sales Agency, Robert, Cincinnati.
Goodrich & Co., F. A., Detroit.
Hillman & Son, J. H., Pittsburg.
McKeefrey & Co., Leetonia, O.
Mohr, J. J., Philadelphia.
Pickands, Brown & Co., Chicago.
Pickands, Mather & Co., Cleveland.
Pilling & Crane, Philadelphia.
Rogers, Brown & Co., Cincinnati.
Shepard, Chas. G., Buffalo.
Stevens, F. B., Detroit.
Thomas Furnace Co., Milwaukee.
Walter-Wallingford & Co., Cincinnati & Pittsburg.

Plumbago:

Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.
Hill & Griffith Co., Cincinnati.
McCullough-Dalzell Crucible Co., Pittsburg.
Obermayer Co., S., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
Ross-Tacony Crucible Co., Philadelphia.
Stevens, F. B., Detroit.

Polishers' & Platers' Supplies:

Stevens, F. B., Detroit.

Riddles:

Adams Co., Dubuque, Ia.
U. S. Chaplet Co., New York.

Sand:

Albany and North River Molding Sand Co., Albany, N. Y.
Dresden Sand Co., Dresden, O.
Paxson Co., J. W., Philadelphia.
Pangborn Co., Thos. W., New York.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.

Sand Blast Machinery:

Drucklieb, C., New York.
Pangborn Co., Thos. W., New York.
Paxson Co., J. W., Philadelphia.
Tilghman-Brooksbank Sand Blast Co., Philadelphia.

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